Montana Fish, Wildlife & Parks

1400 South 19th Avenue
Bozeman, MT 59718

February 7, 2014

To: To: Governor's Office, Sheena Wilson, State Capitol, Room 204, P.O. Box 200801, Helena, MT 59620-0801
Environmental Quality Council, State Capitol, Room 106, P.O. Box 201704, Helena, MT 59620-1704
Dept. of Environmental Quality, Metcalf Building, P.O. Box 200901, Helena, MT 59620-0901
Dept. of Natural Resources & Conservation, P.O. Box 201601, Helena, MT 59620-1601
Montana Fish, Wildlife & Parks:

Director's Office	Parks Division	Lands Section	FWP Commissioners
Fisheries Division	Legal Unit	Wildlife Division	Design & Construction

MT Historical Society, State Historic Preservation Office, P.O. Box 201202, Helena, MT 59620-1202
MT State Parks Association, P.O. Box 699, Billings, MT 59103
MT State Library, 1515 E. Sixth Ave., P.O. Box 201800, Helena, MT 59620
James Jensen, Montana Environmental Information Center, P.O. Box 1184, Helena, MT 59624
Janet Ellis, Montana Audubon Council, P.O. Box 595, Helena, MT 59624
George Ochenski, P.O. Box 689, Helena, MT 59624
Jerry DiMarco, P.O. Box 1571, Bozeman, MT 59771
Montana Wildlife Federation, P.O. Box 1175, Helena, MT 59624
Wayne Hurst, P.O. Box 728, Libby, MT 59923
Jack Jones, 3014 Irene St., Butte, MT 59701
Skyline Sportsmen, PO BOX 173, Butte, MT 59701
Montana TU, PO Box 7186, Missoula, MT 59807
George Grant TU, P.O. Box 563, Butte, MT 59702

Ladies and Gentlemen:

Montana Fish, Wildlife and Parks (FWP) and the Gallatin National Forest (GNF) are jointly requesting public input on a proposed project to restore native westslope cutthroat trout (WCT) to the headwaters of the South Fork Sixteenmile Creek drainage.

Fisheries management actions related to WCT restoration in South Fork Sixteenmile Creek are proposed in the FWP draft environmental assessment. Ground disturbing activities (installation of a permanent fish passage barrier) on forest system lands are proposed in the Forest Service Draft Decision Memo. Public comments regarding fisheries management and/or ground disturbance due to the proposed fish barrier installation will be accepted from February 7, 2014 through March 7, 2014. The documents are available for review at the following links:

FWP Draft Environmental Assessment
(http://fwp.mt.gov/news/publicNotices/environmentalAssessments/restorationAndRehab/

GNF Draft Decision Memo (http://www.fs.usda.gov/projects/gallatin/landmanagement/projects).

This project, if implemented, will restore westslope cutthroat trout to approximately six stream miles within five interconnected tributaries in the headwaters of the South Fork Sixteenmile Creek drainage. Project tasks include:

- Install a permanent fish passage barrier on GNF at the downstream extent of the project area (GNF).
- Restoration of a non-hybridized westslope cutthroat trout population in the Sixteenmile Creek drainage within the GNF boundary by removing non-native trout with rotenone upstream of the fish barrier (FWP).
- Replicate the genetics of nearby populations of WCT within the upper Missouri River drainage by reintroducing fish upstream of the barrier (FWP).

Montana Fish, Wildlife and Parks and Gallatin National Forest are requesting input and comments on the proposed project by March 7, 2014. Public meetings will be held on February 18, 2014 (Bozeman Regional Headquarters) and February 20, 2014 (the Old Sedan Schoolhouse) at 7 pm.

If you have any written comments regarding the proposed treatment and restocking, please mail them to:

Montana Fish, Wildlife & Parks
c/o South Fork Sixteenmile Creek Restoration Comments
1400 South 19th Ave
Bozeman, MT 59715.
rspoon@mt.gov

If you have any questions regarding the proposed project, please call Ron Spoon (MFWP, Area Fisheries Biologist) at (406) 266-4237.

Thanks for your time and consideration of this proposed native fish restoration project.

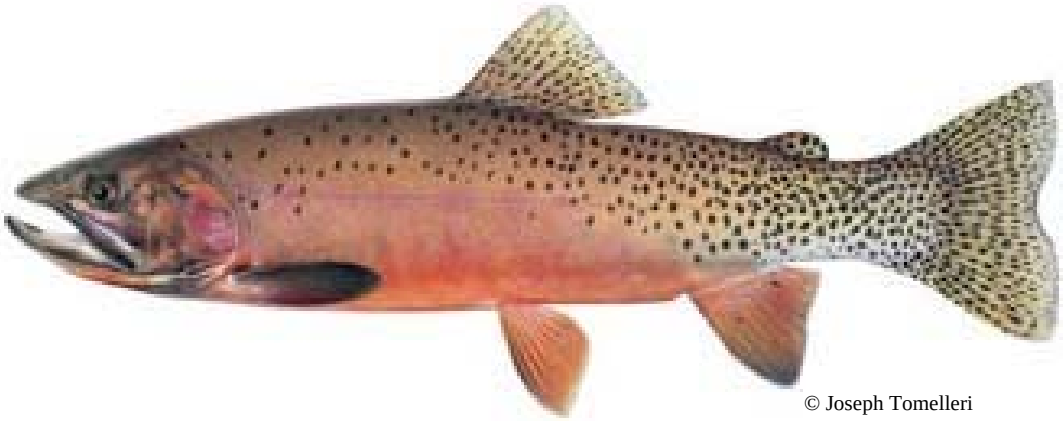
Sincerely,

Patrick J. Flowers
Region Three Supervisor

Attachment

Environmental Assessment of the Removal of Nonnative Fishes with Rotenone and Restoration of Westslope Cutthroat Trout in South Fork Sixteenmile Creek

Draft Environmental Assessment



© Joseph Tomelleri

January 30, 2014

Montana Fish, Wildlife & Parks

Region 3 Office

1400 South 19th Street

Bozeman, Montana 59718-5496

Montana Fish, Wildlife & Parks

Table of Contents

List of Figures

List of Tables

List of Abbreviations

BMP	Best management practice
DEGEE	Diethyl glycol monoethyl ether
DEQ	Montana Department of Environmental Quality
EA	Environmental Assessment
EIS	Environmental impact statement
EPA	US Environmental Protection Agency
FWP	Montana Fish, Wildlife & Parks
GNF	Gallatin National Forest
$KMnO_4$	Potassium permanganate
MCA	Montana Code Annotated
MCTSC	Montana Cutthroat Trout Steering Committee
MEPA	Montana Environmental Policy Act
MNHP	Montana Natural Heritage Program
MOU	Memorandum of understanding
MSDS	Material safety data sheet
NEPA	National Environmental Policy Act
PEG	Polyethylene glycol
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service

Executive Summary

South Fork Sixteenmile Creek originates in the northeast portion of the Bridger Range and flows north until its confluence with the Middle Fork Sixteenmile Creek near Maudlow, Montana (Figure 1). Historically, the Sixteenmile Creek watershed supported westslope cutthroat trout *Oncorhynchus clarkii lewisi* throughout 330 miles of stream. Nonhybridized westslope cutthroat trout no longer occupy the Sixteenmile Creek watershed, and the current fishery consists of hybridized fish possessing genes from westslope cutthroat trout, rainbow trout *O. mykiss*, and Yellowstone cutthroat trout *O. c. bouvieri*. In addition, brook trout *Salvelinus fontinalis* and brown trout *Salmo trutta* occupy a significant portion of the lower Sixteenmile Creek watershed, although they have not yet expanded into the project area. This scenario of local extirpation of nonhybridized westslope cutthroat trout and replacement by hybrids or nonnatives is common in the upper Missouri River basin, with core or conservation[1] populations occupying less than 8% of their historic habitat (Shepard et al. 2005).

The reduced abundance and distribution of westslope cutthroat trout within its historic range, especially east of the Continental Divide, has spurred considerable concern over the persistence of the subspecies, and has resulted in lawsuits to include westslope cutthroat trout for protection under the Endangered Species Act. Although the U.S. Fish and Wildlife Service has decided listing was unwarranted, fisheries managers, conservation groups, tribes, and various industry concerns joined to form the Montana Cutthroat Trout Steering Committee (MCTSC) to guide restoration of westslope cutthroat trout and Yellowstone cutthroat trout within their historic ranges. This collaboration has resulted in development of a memorandum of understanding (MOU) designed to ensure the long-term, self-sustaining persistence of westslope cutthroat trout (MCTSC 2007). This project is consistent with the third objective of the MOU, which calls for reestablishing nonhybridized populations of westslope cutthroat trout populations where they have been extirpated. The action is also consistent with Montana Fish, Wildlife & Park's (FWP's) *Statewide Fisheries Management Plan* (FWP 2013), which specifies restoring nonhybridized westslope cutthroat trout to at least 20% of its historic range in the upper Missouri Basin.

This component of the project would be part of a larger effort to restore westslope cutthroat trout in Sixteenmile Creek. The Gallatin National Forest (GNF) and Montana Fish, Wildlife & Parks (FWP) would collaborate on this multiphase project. This document addresses removal of the existing fishery and reestablishment of westslope cutthroat trout. Both agencies would be involved in implementation of this phase. The GNF would be the lead agency in construction of a barrier to prevent reinvasion of nonnative species. The GNF has prepared a draft decision memo for the barrier construction component.

[1] Core populations have less than 1% of genes of rainbow trout or Yellowstone cutthroat trout origin. Conservation populations possess less than 10% of genes

This document is an environmental assessment (EA) of the potential consequences of various alternatives for two components of the project – removal of nonnative fishes, followed by reintroduction of native westslope cutthroat trout. Construction of the fish passage barrier on USFS land is concurrently being reviewed using the NEPA process. EAs are a requirement of the Montana Environmental Policy Act (MEPA), which requires state agencies to consider the environmental, social, cultural, and economic effects of proposed actions. This EA considers three alternatives:

1. No action.
2. The proposed action is the removal of fish using rotenone, followed by reintroduction of nonhybridized westslope cutthroat trout transferred from a nearby wild source. Piscicide treatment will be limited to waters within the project area (Figure 2) followed by a detoxification zone created by the release of potassium permanganate ($KMnO_4$). A separate yet essential component of this project entails construction of a barrier, which would be located about 16 miles upstream from South Fork Sixteenmile Creek's confluence with the middle fork. The GNF will prepare an EA for the barrier under their NEPA requirements. The purpose of the barrier is to prevent reinvasion of nonnatives and hybrids, which are abundant throughout the larger watershed.
3. The third alternative would entail removing the existing fishery using electrofishing, other mechanical means such as angling, or both, and reintroducing nonhybridized westslope cutthroat trout. This option would also include barrier construction to prevent reinvasion of nonnative fishes and hybrids.

Alternative 2 is the preferred alternative. Evaluation of the potential effects of this approach indicates it would have minor, short-term effects on water quality lasting no more than 2 to 3 days. During the treatment, $KMnO_4$ would detoxify rotenone beginning at the barrier. Rotenone is toxic to gilled organisms at exceedingly low concentrations. Because of this, treatment would result in a temporary reduction of gilled aquatic invertebrates, although many species are resilient to this level of rotenone. The concentration of rotenone needed to kill fish is far below levels that would be harmful to other organisms drinking the water or scavenging dead fish and invertebrates. Mitigation would relate to actions that minimize the concentration of rotenone in treated waters, limiting the spatial extent of rotenone treatment, and ensuring protection of the applicator's health. Conducting a bioassay would allow determination of the lowest effective concentration of rotenone necessary to achieve project goals. Moreover, detoxification stations would limit the extent of rotenone treated area. Applicators would wear protective gear as described to prevent dermal or inhalation exposure.

MEPA also requires public involvement and opportunity for the public to comment on projects undertaken by state agencies. A 30-day public comment period will extend from February 7, 2014 to March 7, 2014. Public meetings will be held at 7:00 pm on February 18th at the FWP

Headquarters, 1400 South 19th Avenue in Bozeman and 7:00 pm on February 20th at the Sedan Schoolhouse in Sedan, MT. Interested parties should send comments to:

Ron Spoon
Montana Fish, Wildlife & Parks
1400 S. 19th Ave
Bozeman, MT 59715
(406) 266-4237
rspoon@mt.gov

1.0 PROPOSED ACTION DESCRIPTION

1.1 Type of Proposed Action

The action is a native fish conservation project entailing removal of nonnative species and reintroduction of native westslope cutthroat trout.

1.2 Agency Authority for Proposed Action

Authority to conduct the proposed actions comes from the Montana Administrative Code (§87-1-702). Specifically, this statute authorizes FWP "to perform such acts as may be necessary to the establishment and conduct of fish restoration and management projects".

FWP powers and duties: The department shall implement programs that:

(i) manage wildlife, fish, game, and nongame animals in a manner that prevents the need for listing under §87-5-107 or under the federal Endangered Species Act, 16 U.S.C. 1531, et seq.;

(ii) manage listed species, sensitive species, or a species that is a potential candidate for listing under §87-5-107 or under the federal Endangered Species Act, 16 U.S.C. 1531, et seq., in a manner that assists in the maintenance or recovery of those species. Section 87-1-201(9)(a) M.C.A.

1.3 Estimated Commencement Date and Schedule

Barrier construction would commence during summer 2014 or 2015. FWP and the GNF would collaborate on the piscicide treatment, which would occur in late summer to early fall after completion of the barrier, and would take 2 to 3 days to complete. Additional treatments may follow in the next year if a full fish kill is not achieved.

1.4 Name and Location of Project

The name of this project is *Removal of Nonnative Fishes with Rotenone and Restoration of Westslope Cutthroat Trout in South Fork Sixteenmile Creek*. South Fork Sixteenmile Creek converges with the Middle Fork Sixteenmile Creek about 5 miles east of Maudlow, Montana (Figure 2). The project area is within the extreme headwaters of the South Fork Sixteenmile Creek, with the majority of stream lying within the GNF. The estimated cost for the project is $8,900, which is the fraction of mechanical removal, which would take multiple crews over several years.

1.5 Project Size (Acres Affected)

		Acres/miles			Acres/miles
(a)	Developed	0	(d)	Floodplain	< 0.01
	Residential	0			
	Industrial	0	(e)	Productive	0
				Irrigated cropland	0
(b)	Open space/woodlands/recreation	0		Dry cropland	0
				Forestry	0
				Rangeland	0
(c)	Wetlands/riparian areas	< 0.003		Other	0
			(f)	Stream miles	6

1.6 Name and Address of Project Sponsor

Ron Spoon
Montana Fish, Wildlife & Parks
1400 S. 19th Avenue
Bozeman, MT 59715
(406) 266-4237
rspoon@mt.gov

1.7 Project Maps

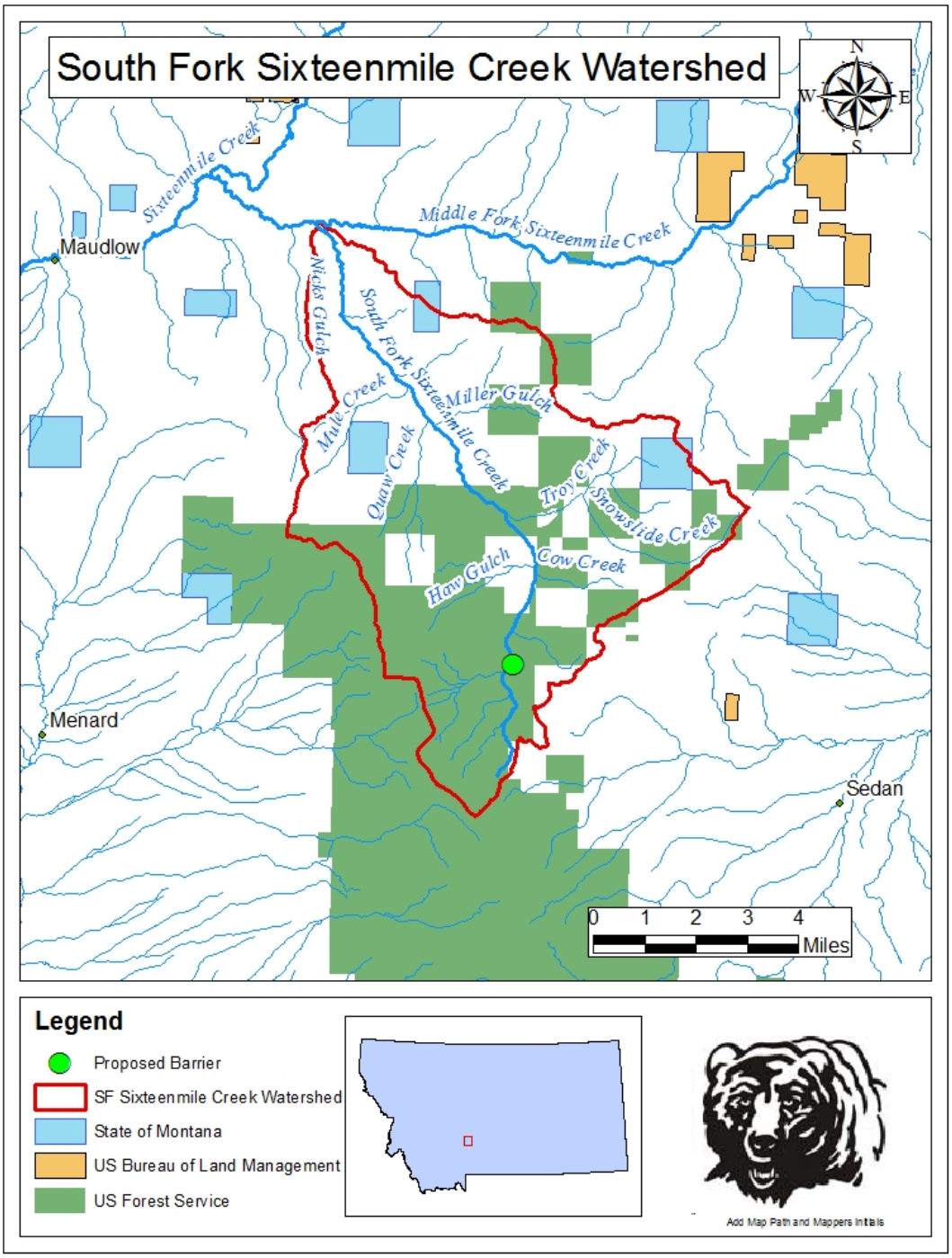


Figure 1: Overview of South Fork Sixteenmile Creek watershed.

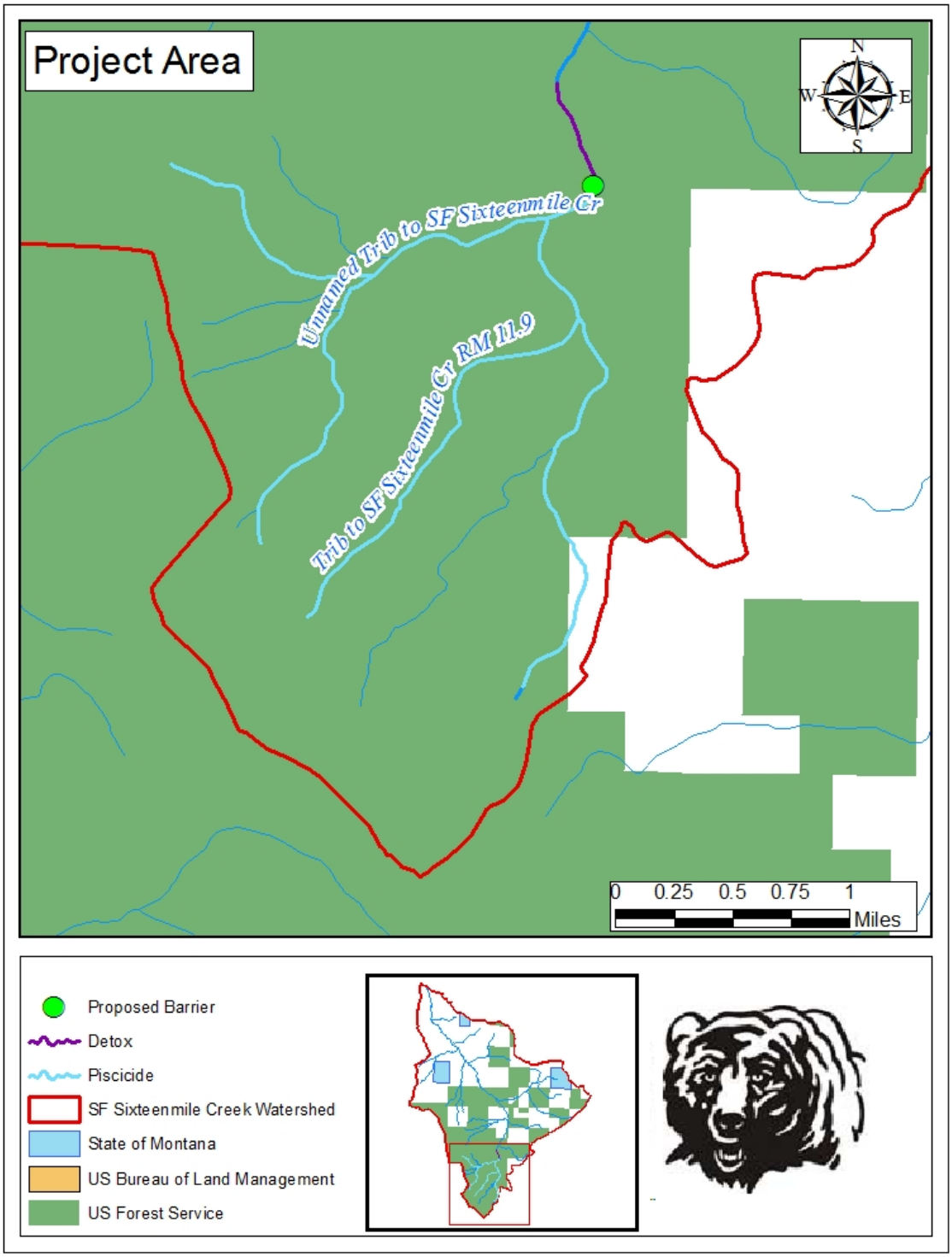


Figure 2: South Fork Sixteen Creek westslope cutthroat trout restoration project area. (Coordinates of proposed barrier are longitude/latitude 45.9965°N/˙110.9842°W. Legal description is T3N R6E section 21)

1.8 Narrative Summary of the Proposed Action and Purpose of the Proposed Action

1.8.1 Status of Westslope Cutthroat Trout in the United States of America including Montana

The westslope cutthroat trout is one of two subspecies of cutthroat trout that are native to Montana. Similar to Yellowstone cutthroat trout, westslope cutthroat trout have declined substantially in abundance and distribution within its historic range (Shepard et al. 2005). Before westward expansion and settlement, westslope cutthroat trout were widely distributed throughout the panhandle of Idaho and much of the western half of Montana (Figure 3). In addition, westslope cutthroat trout were native to several isolated watersheds in Washington and Oregon. Westslope cutthroat trout no longer occupy a considerable portion of its historic habitat and most of the remaining populations show some level of hybridization with nonnative trout species.

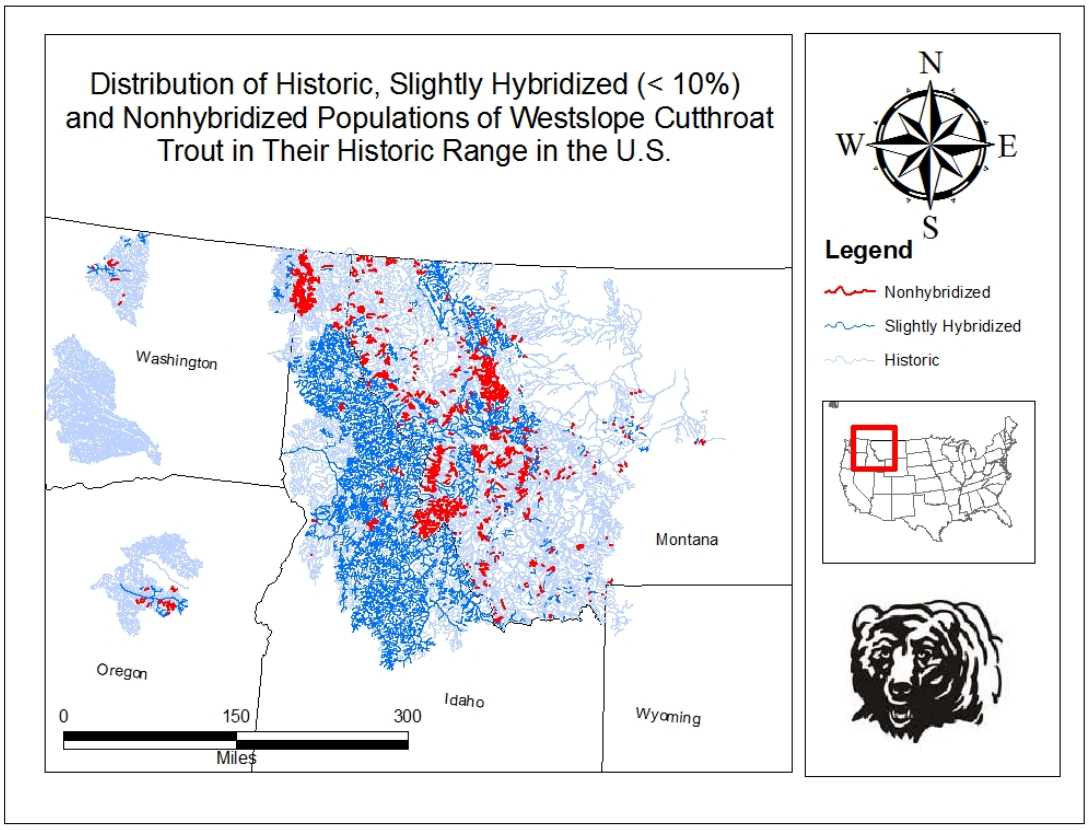


Figure 3: Distribution of historic, slightly hybridized, and nonhybridized populations of westslope cutthroat trout across its native range (State of Washington fisheries database 2009). Population hybridization is classified based on genetic data or biological opinion.

For conservation planning, Montana considers the Missouri River watershed, east of the Continental Divide, as a separate management area (Figure 4). Compared to the westslope cutthroat trout populations on the west side of the Continental Divide, nonhybridized populations in the Missouri River drainage are exceedingly rare and occupy less than 4% of their historical habitat. More slightly hybridized populations exist than nonhybridized populations, but these are also rare, fragmented, and typically relegated to small reaches of headwater streams. Projects that preserve, restore, or protect nonhybridized populations of westslope cutthroat trout are necessary to prevent the extinction of the species and decreases justification for listing westslope cutthroat trout under the Endangered Species Act.

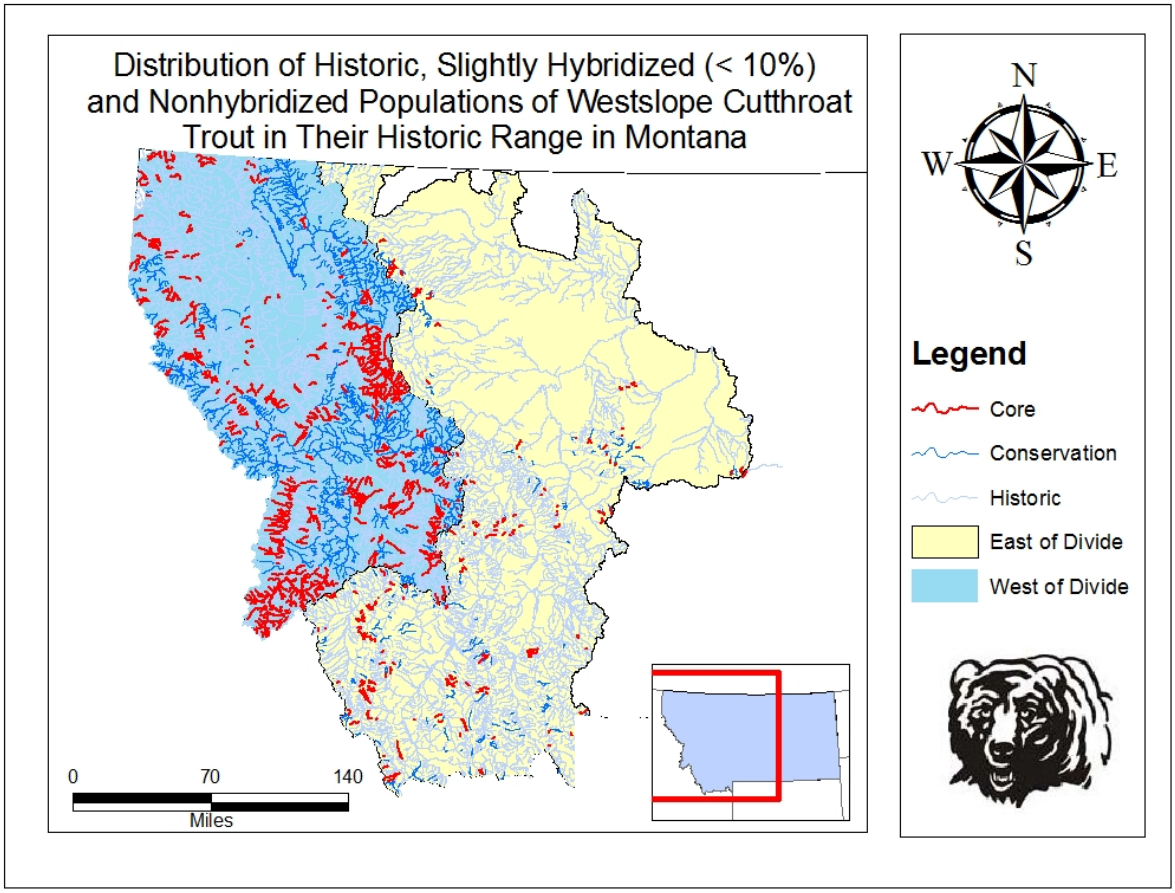


Figure 4: Distribution of historic, slightly hybridized (< 10%), and nonhybridized populations of westslope cutthroat trout in its historic range in Montana.

Although human-caused disturbances such as habitat degradation, dewatering, and barriers to fish movement have contributed to declines of westslope cutthroat trout, introduction of nonnative species has been the primary cause of reductions in distribution and abundance throughout their native range (Behnke 1992). Rainbow trout and Yellowstone cutthroat trout

readily interbreed with westslope cutthroat trout resulting in formation of hybrid swarms (Allendorf and Leary 1988; Hitt et al. 2003). Brook trout are highly competitive with cutthroat trout and can rapidly displace cutthroat trout, especially at higher elevations (Dunham et al. 2002; Peterson et al. 2004). Although not as well documented, brown trout may also influence westslope cutthroat trout populations through competition or predation. The remaining populations of westslope cutthroat trout east of the divide remain primarily because barriers to upstream migration, such as waterfalls, culverts, or dry reaches of channes have prevented invasion of nonnative species.

Unfortunately, humans were the means by which nonnatives arrived in the Sixteenmile Creek watershed. In past decades, fisheries agencies throughout the West stocked large numbers of nonnative species, or subspecies, into streams and lakes to compensate for overfishing, habitat degradation, pollution, or to augment recreational angling. This lack of foresight resulted in marked reductions in distribution and abundance of native cutthroat trout.

Stocking in the Sixteenmile Creek drainage was substantial, with over 400,000 Yellowstone cutthroat trout introduced from 1928 to 1939, 12,000 brown trout in 1950, and over 350,000 brook trout from 1934 to 1953. Stocking of rainbow trout occurred across several decades with 148,000 stocked from 1938 through 1963. The last stocking of rainbow trout was in 1989 with almost 500 fish released. The result of these efforts is a highly hybridized population of westslope cutthroat trout and a downstream presence of nonnative brown trout and brook trout.

The role of species introductions in declines of inland native trout is substantial and well documented. At 10-year intervals, the American Fisheries Society publishes a list of imperiled freshwater and diadromous fishes[2] (Jelks et al. 2008). Among this list are 35 freshwater fishes of the genus *Oncorhynchus*, which includes subspecies of cutthroat and distinct populations of rainbow trout, golden trout (*O. aquabonita*) and redband trout (*O. mykiss mykiss*). Other members of the genus on the list include Mexican trout (*O. chrysogaster*), Apache trout (*O. gilae apache*), and Gila trout (*O. g. gilae*). Two of these unique fishes are extinct or probably extinct. Species introductions were a primary factor in the decline of these fisheries.

Other evidence implicating nonnatives as a primary cause of decline in native trout and their relatives entails examining fish composition in streams flowing through areas lacking appreciable human disturbance. The relatively pristine habitats in national parks and designated wilderness provide a natural laboratory for evaluating the relative roles of habitat degradation and nonnative species in declines of native cutthroat and their relatives. For example, in the portions of the Bob Marshall Wilderness east of the Continental Divide nonhybridized and slightly hybridized westslope cutthroat trout populations occupy about 15 stream miles, and a barrier protects every one of these populations (Figure 5). In contrast, rainbow trout occupy over

[2] Diadromous fish species utilize both saltwater and freshwater habitats to complete their life history.

150 miles of stream within the east side of the wilderness area and brook trout occur in over 170 miles. Yellowstone National Park and Glacier National Park are experiencing the same threats, including hybridization with rainbow trout, and expansion and ultimate displacement of cutthroat trout by brook trout, despite minimal human disturbance to streams (Yellowstone National Park 2010; Glacier National Park 2011). These findings underscore the threat posed by nonnative species, even in undisturbed habitat, and the need to remove their populations in select streams and lakes to ensure the protection and persistence of our native trout.

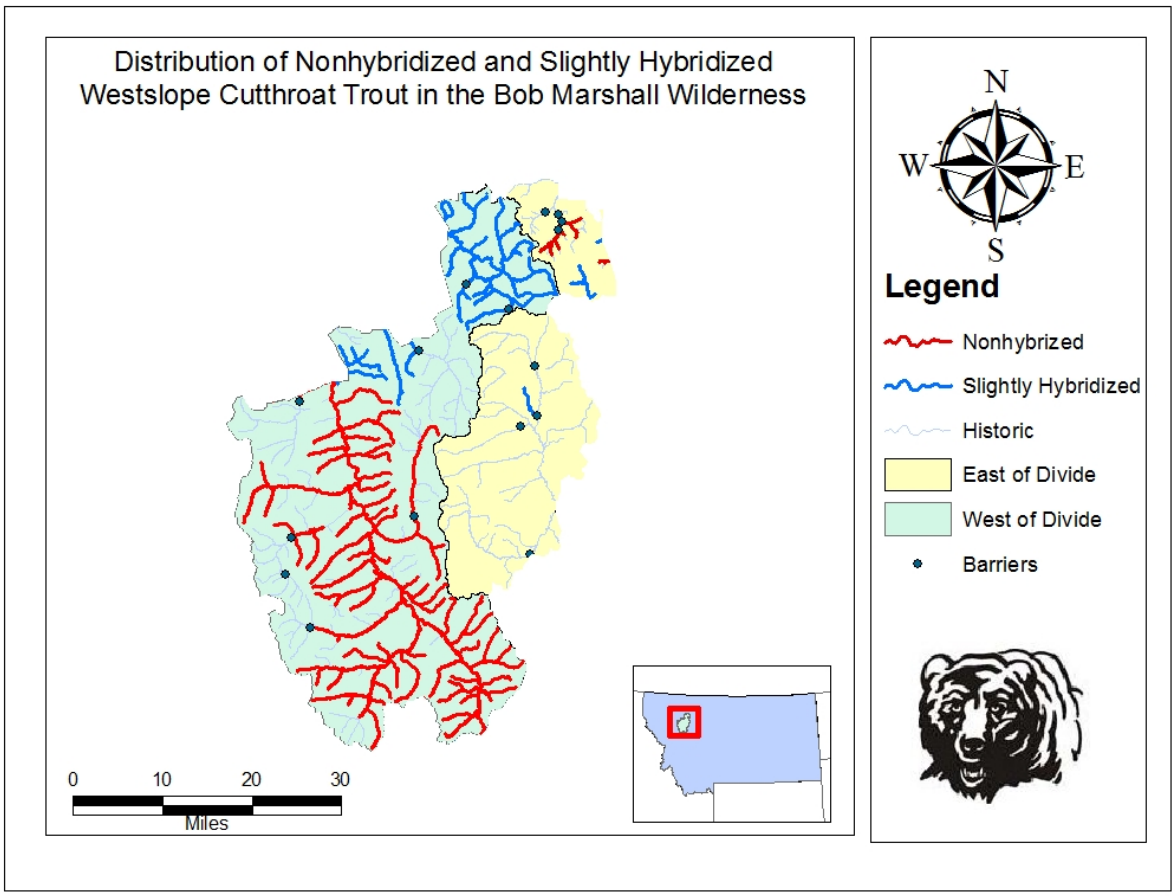


Figure 5: Distribution of nonhybridized and slightly hybridized westslope cutthroat trout in the Bob Marshall Wilderness.

Marked reductions in distribution and abundance of westslope cutthroat trout in their historic range has resulted in their designation as a species of special concern (MNHP and FWP 2012) and has resulted in litigation for inclusion of westslope cutthroat trout for protection under the Endangered Species Act. In response to these declines, designated status, and potential future lawsuits, a diverse group of state and federal agencies, agricultural and silvicultural interests, and environmental advocacy groups developed a memorandum of understanding (MOU) to guide

conservation, protection, and restoration of cutthroat trout in Montana (MCTSC 2007). This MOU places reestablishment of nonhybridized cutthroat trout in waters where they have been lost as its third most important objective. The other conservation objectives are to protect and secure the remaining populations, especially those lacking hybridization, and continued survey to locate new populations.

Table 1: Participants and signatories on cutthroat trout conservation MOU (MCTSC 2007).

Category	*Entity*	*MCTSC Participants*	*Agreement Signatories*
Conservation and Resource Users	American Wildlands	✓	✓
	Federation of Fly Fishers	✓	✓
	Greater Yellowstone Coalition	✓	✓
	Montana Chapter of the American Fisheries Society (MCAFS)	✓	✓
	Montana Trout Unlimited	✓	✓
	Montana Wildlife Federation	✓	✓
Industry	Montana Farm Bureau	✓	✓
	Montana Stockgrowers Association	✓	✓
	Plum Creek Timber Company	✓	✓
Resource Agencies (federal)	Bureau of Land Management (BLM)	✓	✓
	Glacier National Park	✓	✓
	Natural Resources and Conservation Service (NRCS)	✓	✓
	U.S. Fish and Wildlife Service (USFWS)		✓
	U.S. Forest Service (USFS)	✓	✓
	Yellowstone National Park (YNP)	✓	✓
Resource Agencies (state)	Department of Environmental Quality (DEQ)		✓
	Department of Natural Resources and Conservation (DNRC)	✓	✓
	Montana Fish, Wildlife & Parks (FWP)	✓	✓
Tribes	Blackfeet Tribe	✓	✓
	Confederated Salish and Kootenai Tribes	✓	✓
	Crow Tribe	✓	✓

FWP recently finalized the *Statewide Fisheries Management Plan* (FWP 2013). The proposed project helps to achieve the goals and objectives of this plan. In particular, the plan specifies a goal of restoring westslope cutthroat trout to 20% of its historically occupied habitat in the Missouri River watershed, with populations spread out geographically within the historic range. The broad distribution is a cautious approach that prevents catastrophic events, such as floods, fire, drought, or disease, from affecting all populations. Populations unaffected by severe disturbance can serve as donor populations to repopulate extirpated populations.

1.8.2 Proposed Action

The proposed action is a native species conservation project involving reestablishment of westslope cutthroat trout in the headwaters of South Fork Sixteenmile Creek. This action consists of two components. This EA addresses removal of the existing fishery consisting of hybrids of westslope cutthroat trout, Yellowstone cutthroat trout, and rainbow trout. The extent of the hybridization varies throughout the project area, but is greater than 10%, which affords no particular conservation status other than managing it as a sport population (MCTSC 2007). Mottled sculpin (*Cottus bairdi*) are also present and this project would include reintroduction of this native species following FWP's fish transfer protocols. Hybrids of cutthroat trout and sculpin are the only species ever collected within the project area (B.C. Roberts, personal communication, GNF). However, brook trout, brown trout, and longnose dace (*Rhinichthys cataractae*) reside in downstream portions of South Fork Sixteenmile Creek. Should longnose dace be present within the project area, they also would be reintroduced into these waters after treatment.

The second component would be construction of a barrier to prevent reinvasion of nonnative fishes (see Figure 2). A draft decision memo, developed by the GNF through their National Environmental Policy Act (NEPA), examines alternatives and potential consequences of barrier construction. To provide the reader with a better understanding of the complete project, the FWP EA briefly describes barrier construction; however, the draft decision memo prepared by the GNF will include more details on design specifications, mitigation, and construction best management practices (BMPs).

Removal of the existing fish in South Fork Sixteenmile Creek would entail the use of rotenone. FWP has a long history of using rotenone to manage fish populations in Montana, spanning as far back as 1948. FWP has administered rotenone projects for a variety of reasons, but rotenone is principally applied to improve angling quality or for native fish conservation.

Rotenone is a naturally occurring substance derived from the roots of tropical plants in the pea family (Fabaceae), such as the jewel vine (*Derris* spp.) and lacepod (*Lonchocarpus* spp.), which are found in Australia and its surrounding Pacific islands, southern Asia, and South America. Native people have used locally available rotenone for centuries to capture fish for food. Fisheries managers in North America have used rotenone since the 1930s. Rotenone is also a natural insecticide, and was formerly used in organic gardening and to control parasites such as lice on domestic livestock (Ling 2002).

Rotenone acts by inhibiting oxygen transfer at the cellular level. Fish are especially vulnerable to low levels of rotenone, as they readily absorb rotenone into the bloodstream through the thin cell layers of the gills. Mammals, birds, reptiles, and other non-gill breathing organisms lack this rapid absorption route into the bloodstream, and can tolerate exposure to concentrations that are much higher than levels than are lethal to fish.

CFT Legumine™ (Prentiss 2007a) is the brand of rotenone selected to treat flowing waters in the project area. The concentration of CFT Legumine applied would follow the manufacturer recommendations for "normal pond use," which would be amounts of 0.5 to 1 part per million (ppm). Once diluted in the drip stations and the stream, the effective concentration of rotenone would be 0.025 parts per billion (ppb) to 0.05 ppb. To put the effective concentration of rotenone into perspective, these concentrations are roughly equal to 1/400 to 1/800 of a grain of table salt per liter. This concentration does not pose a threat to any organisms likely to present in the project area, except for fish and some gilled invertebrates. Timing of application would protect amphibians and aquatic invertebrates would recolonize through natural mechanisms.

A second type of rotenone may be applied on a limited basis. "Dough balls" consist of a mixture of Prentox™ (Prentiss 2007b), which contains 7% rotenone, sand, and gelatin. These "dough balls" are effective in preventing fish from finding refuge in springs, seeps, and at the mouths of small, fishless tributaries.

The rotenone treated area on South Fork Sixteenmile Creek would include all fish bearing waters upstream of the barrier site, which is approximately 6 miles of stream. Several tributaries are either ephemeral or lack sufficient flow or habitat to support fish; however, installation of drip stations (Figure 6) or placement of rotenone treated "dough balls" near the confluence of these streams would eliminate the potential for fish to seek refuge in the tributary.

Drip stations containing diluted rotenone would be placed at regular intervals from 1 to 2 hours of water travel time (Figure 6). Regularly spaced drip stations are necessary because of rapid natural breakdown, dilution, and detoxification of rotenone in stream environments. Each drip station dispenses a precise amount of diluted rotenone over 4 to 8 hours. The required concentration of CFT Legumine in drip stations depends on existing stream flow measured in cubic feet per second and the results of on-site bioassays.

Figure 6: Example of a drip station used to deliver CFT Legumine.

Rotenone detoxifies through three potential mechanisms: natural oxidation, dilution by freshwater, and introduction of an oxidizing/neutralizing agent, such as potassium permangate ($KMnO_4$). Factors influencing natural oxidation include water temperature, water chemistry, and exposure to organic substances, air, and sunlight (Engstrom-Heg 1972; Gilderhus et al. 1986; Loeb and Engstrom-Heg 1970; ODFW 2002; Ware 2002). Dilution occurs through upwellings of groundwater. Flow contributed from tributaries is another mechanism.

Standard FWP procedures will ensure detoxification of rotenone through application of $KMnO_4$ at the barrier site, which limits the spatial extent of the treatment area. Full neutralization of rotenone requires a short mixing zone approximately ¼ to ½ mile downstream from the $KMnO_4$ application site. Application rates of $KMnO_4$ would be based on stream flow and natural background levels of oxidation. A small handheld colorimeter would measure levels of $KMnO_4$ to guide application rates.

Caged sentinel fish would allow evaluation of the toxicity and detoxification downstream of and within the project area. These sentinel fish would be placed upstream from drip stations to ensure toxic concentrations of rotenone are maintained between stations. During treatment, sentinel fish placed downstream of the project area, and replaced regularly, would indicate when the water is no longer toxic. Finally, caged fish downstream from the detoxification zone will also determine efficacy of the detoxification. The CFT Legumine label specifies that once caged fish show no signs of distress for 4 hours, the stream water is no longer toxic, and detoxification can cease.

The goal is to eradicate fish with the first treatment. Nonetheless, occasionally, some fish escape lethal exposure. FWP would ascertain effectiveness of the treatment using electrofishing. In the event the treatment did not result in a complete fish kill, additional treatments may be necessary to fulfill the project's objectives.

Once fish are eradicated from the project area, FWP would return nonhybridized westslope cutthroat trout the project area. FWP would also transplant mottled sculpin and longnose dace from downstream the barrier if they are present in the treated portion of South Fork Sixteenmile Creek. Several options for restocking westslope cutthroat trout are available. Planting live fish (juveniles and adults) is among the alternatives. The use of on-site incubators containing fertilized or eyed eggs is another potential approach. Regardless of the mode of reintroduction, the fish placed in South Fork Sixteenmile Creek would come from a nonhybridized population of westslope cutthroat trout from a nearby source. Before transfer of westslope cutthroat trout to South Fork Sixteenmile Creek, FWP would conduct careful analysis of the potential source populations to ensure the population is nonhybridized and disease-free.

1.9 Agencies Consulted During Preparation of the Draft EA

Agency consultation included communications with project partners, permitting agencies, and entities with information relevant to potential consequences of this project. These included the GNF, Montana Department of Environmental Quality, and the Montana Natural Heritage Program (MNHP).

2.0 ENVIRONMENTAL REVIEW

2.1 Physical Environment

2.1.1 Land Resources

1. Land Resources	Impact				Can Impact be Mitigated?	Comment Index
Would the proposed action result in:	Unknown	None	Minor	Potentially Significant		
a. Soil instability or changes in geologic substructure?			X		Yes	1a
b. Disruption, displacement, erosion, compaction, moisture loss, or over-covering of soil, which would reduce productivity or fertility?			X		Yes	1b
c. Destruction, covering, or modification of any unique geologic or physical features?		X				
d. Changes in siltation, deposition, or erosion patterns that may modify the channel of a river or stream, or the bed or shore of a lake?			X		Yes	1d
e. Exposure of people or property to earthquakes, landslides, ground failure, or other natural hazard?		X				

Comments on 1a, 1b, and 1d: Effects on Soil Productivity, Erosion and Deposition
Construction of a concrete barrier entails use of heavy equipment including tracked excavators, concrete trucks, skid steers and haul trucks, all of which will compact soil and disturb vegetation. Ground disturbance would be limited to the area around the barrier and a staging area for equipment and materials. Heavy equipment would access the barrier site along USFS roads and a short section of old roadbed near the project site. Reclamation and re-vegetation of the old roadbed will occur after construction. Reclamation actions would include scarification and seeding of the old roadbed, which would mitigate for damage to the area. The dimensions of the disturbance are currently unknown as designs for the barrier are not yet complete.

Barrier construction requires a series of permits, which include description of BMPs and reclamation during and following construction. These permits include the 124 permit required under the Montana Stream Protection Act (SPA124), the Short-Term Water Quality Standard for Turbidity, or 318 authorization, from Montana Department of Environmental Quality, and a 404 permit from the Army Corps of Engineers. If the barrier site is within designated floodplain, a floodplain permit issued by the county is necessary. The GNF will prepare a joint permit application, which addresses all the necessary permitting. The permit application requires

considerable detail on limiting disturbance, protecting water quality, and reclaiming disturbed areas.

General BMPs would include, but not be limited to the following:

- Installation of temporary diversions for storm water runoff and dewatering the work area would reduce delivery of sediment to South Fork Sixteenmile Creek during construction. A professional engineer would design the structure and provide details of dewatering and associated BMPs to reduce sediment loading. BMPs may include, but are not limited to temporary berms, cofferdams, sediment retention basins, ditches, silt fencing, straw bales or straw wattles, straw mulch, and erosion control matting.

- The contractor would follow the specifications in the design package that describe the engineer designed storm water, dewatering, and erosion control measures. The contractor would prevent sediment loading from construction by implementing BMPs.

- All dewatering flows collected from open sumps, trenches, or excavations would flow through a sediment retention structures before discharge to South Fork Sixteenmile Creek.

- Installation of sediment reduction BMPs along the margin of South Fork Sixteenmile Creek would occur before any earthwork that could release sediment to South Fork Sixteenmile Creek. These BMPs would remain until vegetation establishes and can effectively filter sediment contributed from adjacent areas. Reclamation of disturbed areas would include application of top soil, a native plant seed mixture, and mulch.

The barrier would result in alteration of deposition patterns upstream of the structure. Typically, bed load fills the area impounded by the barrier. This could occur during one large runoff event or may take several years. The result would be the top of the barrier being at grade with the streambed upstream of the structure.

Cumulative Effects on the Physical Environment:

The barrier would bring short-term disturbance of the surrounding vegetation and soil, which would occur during the construction period and a short recovery period. The barrier should not require maintenance, nor will it create unforeseen alterations to land resources. Therefore, the barrier construction component would not result in cumulative impacts to land resources.

2.1.2 Water

2. Water	Impact				Can Impact be Mitigated?	Comment Index
Would the proposed action result in:	Unknown	None	Minor	Potentially Significant		
a. Discharge into surface water or any alteration of surface water quality, including but not limited to temperature, dissolved oxygen, or turbidity?			X		Yes	2a
b. Changes in drainage patterns or the rate and amount of surface runoff?		X				
c. Alteration of the course or magnitude of flood water or other flows		X				2c
d. Changes in the amount of surface water in any body of water, or creation of a new body of water?		X				
e. Exposure of people or property to water-related hazards such as flooding?		X				
f. Changes in the quality of groundwater?		X				2f
g. changes in the quantity of groundwater?		X				
h. Increase in risk of contamination of surface water or groundwater?			X		Yes	2c and 2f
i. Effects on any existing water right or reservation?		X				2i
j. Effects on other water users as a result of any alteration in surface or groundwater quality?		X				2j
k. Effects on other users as a result of any alteration in surface or groundwater quantity?		X				
l. Would the project affect a designated floodplain?		X				
m. Would the project result in any discharge that would affect federal or state water quality regulations?			X		Yes	2m

Comment 2a: Alterations in Water Quality

Short-term alterations in water quality would result from the barrier construction and piscicide application components of this project. The EA developed by the GNF will expand on water quality alterations from barrier construction, which would mostly be related to sediment delivery.

The GNF's draft decision memo will provide detailed BMPs and mitigative actions relating to barrier construction and water quality, although section 2.1.1 Land Resources describes the general approach. The rest of this section will address the piscicide component.

This project would involve discharge of rotenone into South Fork Sixteenmile Creek. Rotenone is an insecticide formerly used in organic agriculture and home gardening, as well as being an effective piscicide. Rotenone comes from the roots and stems from a variety of tropical and subtropical plants in the pea family (Fabaceae). The molecular constituents of rotenone are carbon, hydrogen, and oxygen and detoxification entails breaking rotenone into these nontoxic components. Rotenone is relatively inexpensive and is a routine method to remove unwanted fish from lakes and streams. Rotenone acts by blocking the ability of tissues to use oxygen, which causes fish to asphyxiate quickly.

Rotenone is a highly reactive molecule, which causes its quick decomposition in the environment. This degradability is in marked contrast to some pesticides used in nonorganic agriculture. Organochlorines are synthetic pesticides comprised of chlorinated hydrocarbons, and include chemicals such as DDT, heptachlor, and chlordane. These compounds persist in the environment long after their release, making the behavior and fate of organochlorine pesticides substantially different from rotenone, which breaks down within days, or less, in a stream or soil environment.

CFT Legumine (Prentiss 2007a) is the rotenone formulation proposed for this project. The EPA has registered this formula (Reg. No. 75338-2), and approved its use as a piscicide. Information on its chemical composition, persistence in the environment, risks to human health, and ecological risks come from a number of sources including material data safety sheets (MSDS) and manufacturer's instructions. A MSDS is a form detailing chemical and physical properties of a compound, along with information on safety, exposure limits, protective gear required for safe handling, and procedures to handle spills safely. In addition, Fisher (2007) analyzed the concentrations of major and trace constituents in CFT Legumine, evaluated the toxicity of each, and examined persistence in the environment.

The MSDS for CFT Legumine lists three categories of ingredients for this formula (Table 2). Rotenone comprises 5% of CFT Legumine by weight. Associated resins account for 5%, and the remaining 90% are inert ingredients, of which the solvent n-methylpyrrolidone is a component. Additional information in the MSDS confirms rotenone's extreme toxicity to fish.

Table 2: Composition of CFT Legumine from material safety data sheets (MSDS)

Chemical Ingredients	*Percentage by Weight*	*CAS. No.*[1]	*TLV*[2] *(units)*
Rotenone	5.00	83-79-4	5 mg/m^3
Other associated resins	5.00		
Inert ingredients including n-methylpyrrolidone	90	872-50-4	Not listed

[1]Chemical abstracts number
[2]A TLV reflects the level of exposure that the typical worker can experience without an unreasonable risk of disease or injury (see 2.2.3 . Risks/Health Hazards)

Analysis of the chemical composition of CFT Legumine found that on average, rotenone comprised 5% of the formula (Fisher 2007), consistent with MSDS reporting. Other constituents were solvents or emulsifiers added to assist in the dispersion of the relatively insoluble rotenone. DEGEE, or diethyl glycol monoethyl ether, a water-soluble solvent, was the largest fraction of the CFT Legumine analyzed. Likewise, n-methylpyrrolidone comprised about 10% of the CFT Legumine™. The emulsifier Fennedefo 99™ is an inert additive consisting of fatty acids and resin acids (by-products of wood pulp and common constituents of soap formulations), and polyethylene glycols (PEGs), which are common additives in consumer products such as soft drinks, toothpaste, eye drops, and suntan lotions. Trace constituents included exceptionally low concentrations of several forms of benzene, xylene, and naphthalene. These organic compounds were at considerably lower concentrations than measured in Prenfish, another commercially available formulation of rotenone, which uses hydrocarbons to disperse the piscicide. Their presence in trace amounts in CFT Legumine relates to their use as solvents in extracting rotenone from the original plant material.

Table 3: Average percent concentrations and ranges of major constituents in CFT Legumine lost (Fisher 2007).

Major CFT LegumineFormula Constituent	*Rotenone*	*Rotenolone*	*n-methylpyrrolidone*	*DEGEE*[1]	*Fennedefo 99*
Average %	5.12	0.718	9.8	61.1	17.1
Range	4.64-5.89	0.43-0.98	8.14-10.8	58.2-63.8	15.8-18.1

[1]diethyl glycol monoethyl ether

Several factors influence rotenone's environmental persistence and toxicity. Rotenone has a half-life of 14 hours at 24 °C, and 84 hours at 0 °C (Gilderhus et al. 1986, 1988), meaning that half of the rotenone is degraded and is no longer toxic in that time. As temperature and sunlight increase, so does degradation of rotenone. Higher alkalinity (>170 mg/L) and pH (>9.0) also increase the rate of degradation. Rotenone binds with and reacts to organic molecules rendering it ineffective, so higher concentrations are required in streams with increased amounts of organic matter. Without detoxification, rotenone would degrade to nontoxic levels in one to several days due to its break down and dilution in the aquatic environment.

Mitigative activities proposed would further reduce the spatial and temporal extent of rotenone toxicity. A detoxification station established immediately downstream from the constructed barrier would release up to $KMnO_4$ to the effective concentration of 0.5 to 1 ppm. $KMnO_4$ rapidly breaks down rotenone into its nontoxic constituents of carbon, oxygen, and hydrogen, with total breakdown occurring within 15 to 30 minutes of exposure, which is typically ¼ to ½-mile of stream travel time. $KMnO_4$ in turn breaks down into potassium, manganese, and water, which are common elements in surface waters, and have no deleterious effects at the concentrations used (Finlayson et al. 2000). In addition, $KMnO_4$ is a commonly used oxidizer in wastewater treatment plants, so its release into streams and rivers is common. The result of release of $KMnO_4$ on water quality would be elimination of toxic concentrations of rotenone. Additional back up detoxification station would be on-site and deployed if necessary.

The concentration of rotenone in treated waters is another factor relating to potential effects from incidental ingestion by other organisms, including humans. The effective concentration of rotenone is extremely low (e.g., 0.025 to 0.05 ppb), which is roughly equivalent to 1/400 to 1/800 of a grain of table salt per liter. The National Academy of Sciences suggested concentrations at 14 ppm pose no adverse effects to human health from chronic ingestion of water (National Academy of the Sciences 1983). Moreover, concentrations associated with acute toxicity to humans are 300-500 mg per kilogram of body weight (Gleason et al. 1969), which means a 160-pound person would have to drink over 23,000 gallons in one sitting to receive a lethal dose (Finlayson et al. 2000). Similarly, risks to wildlife from ingesting treated water are exceptionally low. For example, ¼-pound bird would have to consume 100 quarts of treated water, or more than 40 pounds of fish and invertebrates, within 24 hours, for a lethal dose (Finlayson et al. 2000). The EPA, in their recent re-registration evaluation of rotenone (EPA 2007), concluded that exposure to rotenone, when applied according to label instructions, presented no unacceptable risks to humans and wildlife. In summary, this project would have no adverse effect on humans or wildlife associated with ingesting water, dead fish, or dead invertebrates.

Bioaccumulation of rotenone would not result in threats to human health and the environment under the preferred alternative. Rotenone can bioaccumulate in the fat tissues of fish that are not exposed to toxic levels (Gingerich and Rach 1985). As a complete fish-kill is the goal, and application will occur over a short time period, bioaccumulation would not be a problem. Moreover, breakdown of rotenone in killed fish would also be rapid, so scavengers, such as skunks, mink, or birds would not experience chronic exposure.

Potential toxicity and persistence of the other constituents of the CFT Legumine formulation are additional considerations. Proposed concentrations of n-methylpyrrolidone (about 2 ppm) would have no adverse effects to humans ingesting treated waters. According to the MSDS, ingestion of 1,000 ppm per day for three months does not result in deleterious effects to humans. In addition,

n-methylpyrrolidone would not persist in surface waters given its high biodegradability. This rapid degradation, combined with its low toxicity, makes n-methylpyrrolidone a commonly used solvent in wastewater treatment plants.

Fisher (2007) examined the toxicity and potential persistence of other major constituents in CFT Legumine, including DEGEE, fatty acids, PEGs, and trace organic compounds, (benzene, xylene, naphthalene). With proposed application of CFT Legumine, none of these compounds would violate water quality standards, nor would they reach concentrations shown to be harmful to wildlife or humans. Furthermore, persistence of these chemicals was not a concern. The trace organics would degrade rapidly through photolytic (sunlight) and biological mechanisms. Likewise, the PEGs would biodegrade in a number of days. The fatty acids would also biodegrade, although they would persist longer than the PEGs or benzenes. Nonetheless, these are not toxic compounds, so the relatively longer persistence would not adversely affect water quality. The trace organics would be at exceptionally low concentrations given dilution of the formula present in the drip station, followed by dilution in the stream. These organic compounds would be well below laboratory detection limits or levels that are harmful. Moreover, these are moderately to highly volatile chemicals that would break down through the same mechanisms as rotenone, namely oxidation, dilution, and treatment with $KMnO_4$. Overall, the low toxicity, low persistence, and lack of bioaccumulation indicate the inert constituents in CFT Legumine would have a minor and temporary effect on water quality.

To reduce the potential risks associated with the use of CFT Legumine, the following management practices, mitigation measures, and monitoring efforts would be employed:

1. A pretreatment bioassay would be conducted to determine the lowest effective concentration and travel time of the chemical in the stream.
2. Signs would be posted at trailheads and along the stream to warn people not to drink the water, consume dead fish, or have recreational contact with the water.
3. Piscicide would be diluted in water and dripped into the stream at a constant rate using a device that maintains a constant head pressure.
4. A detoxification station would be set up downstream of the target reach. Potassium $KMnO_4$ would be used to neutralize the piscicide at this point.
5. An additional detoxification would be established downstream from the initial detoxification station as a safeguard.
6. Project personnel would be trained in the use of these chemicals including the actions necessary to deal with spills as prescribed in the MSDS for CFT Legumine.
7. Persons handling the piscicide would wear protective gear as prescribed in the CFT Legumine label.
8. Only the amount of piscicide and potassium permanganate that is needed for immediate use would be held near the stream.

9. Sentinel or caged fish would be located below the detoxification station and within the target reach to determine and monitor the effectiveness of both the rotenone and potassium permanganate.

The presence and fate of dead fish would be another potential alteration of water quality associated with piscicide treatment. Experience has shown that these fish sink in streams and are difficult to find within a few days. Leaving their carcasses to decompose within the stream would keep their nutrients within the stream. This increase in nutrients would likely temporarily increase biomass of algae, macroinvertebrates, and fish.

Comment 2f: Effects on Groundwater

Investigations on the fate and transport of rotenone in soil and groundwater indicate this project would not alter groundwater quality. Rotenone binds readily to soils and is broken down by soil and in water (Engstrom-Heg 1971; Dawson et al. 1991; 1976; Skaar 2001; Ware 2002). Because of its strong tendency to bind with soils, its mobility in most soil types is only one inch, although, in sandy soils, rotenone can travel up to three inches (Hisata 2002). Combined, the low mobility and rapid break down prevents rotenone from contaminating groundwater.

Groundwater investigations associated with several piscicide projects also indicate application of rotenone, and the inert ingredients, would not threaten groundwater quality. California investigators monitored groundwater in wells adjacent to and downstream of rotenone projects, and did not detect rotenone, rotenolone, or any of the other organic compounds in the formulated products (CDFG 1994). Likewise, case studies in Montana have concluded that rotenone movement through groundwater does not occur. For example, FWP monitored a domestic well two weeks and four weeks after applying 90 ppb of rotenone to Lake Tetrault (FWP, unpublished data). This well was down gradient from the lake, and drew water from the same aquifer that drained and fed the lake; however, no rotenone or associated constituents were detectable. FWP monitored groundwater associated with several other rotenone projects, with wells ranging from 65 to 200 feet from the treated waters. Repeated sampling occurred within periods of up to 21 days, with no detectable concentrations of rotenone or the inert ingredients found.

One domestic well lies relatively close to the lower end of the treatment area (GWIC database 2012; http://mbmggwic.mtech.edu/). This well is 1,900 feet from the proposed barrier site and 1,200 feet from the detoxification reach. Given the minute distance rotenone travels through soils (1 to 3 inches), its low mobility in groundwater, and its rapid breakdown, this project would not result in contamination of the neighboring well.

Comment 2i: Effects on Water Rights

This project would have no effects on water rights. The steepness of the stream upstream of the barrier would prevent impoundment of large volumes of water. Therefore, the amount of evaporation from the surface water upstream of the barrier would be negligible.

Comment 2j: Effects on Other Water Users

Rotenone treatment has potential to affect irrigation uses and swimming. CFT Legumine's label prohibits irrigation of crops with treated water, and prohibits "release within ½ mile upstream of a potable water or irrigation diversion." The label prohibits swimming in rotenone-treated water "until the application has been completed, and all pesticide has been thoroughly mixed into the water according to labeling instructions."

Distance from irrigated agriculture and potable water sources, and detoxification would prevent effects on agricultural uses and human health. Detoxification would degrade rotenone to nontoxic levels within 15 to 30 minutes of travel time from the barrier. In addition, irrigated agriculture does not begin until several miles downstream, which exceeds the ½-mile requirement. The nearest private land and potential potable withdrawal is well over ½ mile from the detoxification site.

Regarding contact recreation, this potential action does not pose a threat to human health. To prevent unintentional exposure, FWP would post signs at access points and trailheads informing hikers, anglers, and other recreationalists about the native fish project that would be in process, and instruct them to avoid contact with the water. As rotenone treatment would last 1 to 3 days, this is a short-term and minor effect on recreational uses.

Comment 2m: Discharge Affecting Water Quality Regulations

This project would involve discharge of CFT Legumine, an EPA registered piscicide, to South Fork Sixteenmile Creek and select tributaries. Montana state law (§MCA 75-5-308) allows application of registered pesticides to control nuisance aquatic organisms, or to eliminate undesirable and nonnative aquatic species. FWP would apply rotenone under DEQ's General Permit for Pesticide Application (#MTG87000). DEQ accepted a notice of intent in a letter dated August 13, 2012, that allows FWP to operate under the General Permit for Pesticide Application. These requirements call for minimizing the concentration and duration of chemical to the extent practicable. FWP would accomplish this by performing a bioassay to determine the lowest, effective concentration of rotenone. The detoxification station at the lower end of the treatment area would also reduce the concentration and duration of toxic concentrations of rotenone.

Cumulative Effects on Water

The piscicide treatment would result in short-term toxicity to fish and other gilled organisms for up to 3 days. Detoxification at the downstream end of the project area would limit the spatial extent of toxic water (Figure 2). Even without detoxification, the rotenone would dilute or break down in a matter of days, making the effects on water quality short-term and minor. The other constituents of the CFT Legumine are not toxic at concentrations applied and would break down rapidly through hydrolysis, bacteria, and oxidation (Fisher 2007), as would the $KMnO_4$ when

applied according to the manufacturer's label. Constituents with longer persistence are nontoxic and do not pose a threat to the environment.

2.1.3 Air

3. Air	Impact				Can Impact be Mitigated?	Comment Index
Would the proposed action result in:	Unknown	None	Minor	Potentially Significant		
a. Emission of air pollutants or deterioration of ambient air quality?			X		yes	3a
b. Creation of objectionable odors?		X				
c. Alteration of air movement, moisture, or temperature patterns, or any change in climate, either locally, or regionally?		X				
d. Adverse effects on vegetation, including crops, due to increased emissions of pollutants?		X				

Comments 3a: Emission of Air Pollutants or Deterioration of Ambient Air Quality

Construction of the fish barrier would entail use of heavy equipment that emits diesel exhaust. This alteration would be minor and temporary, as these fumes dissipate rapidly. Likewise, mixing concrete could result in creation of dust. Particulates would disperse and settle quickly, resulting in short-term and minor alterations in air quality. The barrier construction EA will cover this component in more detail. Application of $KMnO_4$ may involve the use of a dry solids volumetric feeder powered by a small generator. Exhaust from the generator should rapidly disperse and would be limited to the treatment period, one to two days.

Cumulative Effects on Air

Effects on air quality would be associated with the barrier construction, which will be covered by a separate EA. A small generator used during detoxification would emit exhaust; however, the fumes would quickly diffuse and affect the area several feet around the generator. In general, effects on air quality would be short-term and would follow BMPs to protect human health and the environment.

2.1.4 Vegetation

4. Vegetation	Impact				Can Impact be Mitigated?	Comment Index
Would the proposed action result in:	Unknown	None	Minor	Potentially Significant		
a. Changes in the diversity, productivity, or abundance of plant species (including trees, shrubs, grass, crops, and aquatic plants)?			X		Yes	4a
b. Alteration of a plant community?		X				
c. Adverse effects on any unique, rare, threatened, or endangered species?		X				4c
d. Reduction in acreage or productivity of any agricultural land?		X				
e. Establishment or spread of noxious weeds?			X		X	4e
f. Would the project affect wetlands, or prime and unique farmland?		X				See 4b

Comment 4a: Changes in the Diversity, Productivity, or Abundance of Plants

During treatment, workers would access drip stations from existing USFS roads and trails. Fieldworkers would trample vegetation along the stream during the placement and monitoring of drip stations and sentinel fish locations; however, the degree of damage to vegetation would not affect plant vigor and trampled plants would recover quickly. Rotenone does not have an effect on plants, which accounts for its use as a pesticide in organic agriculture.

Barrier construction would result in localized disturbance to vegetation at the proposed barrier site and staging area (see Comments on 1a, 1b, and 1d: Effects on Soil Productivity, Erosion and Deposition). Heavy equipment necessary for construction would access the proposed barrier site along an old roadbed. Disturbance of old roadbed would be temporary and minor. Scarification and seeding after the proposed barrier is completed would mitigate damage to the old roadway. The EA prepared by the GNF will expand on BMPs and reclamation of vegetated areas within the barrier project area.

Comment 4c: Effects on Unique, Rare, Threatened or Endangered Species

The Montana Natural History Program does not list any plant species of concern within the township and range in which this project occurs, so no negative effects on rare or special plant species are expected.

Comment 4e: Establishment or Spread of Noxious Weeds

The construction phase has potential to spread noxious weeds through ground disturbance, which promotes establishment of invasive plants, and import of seeds on machinery. Several actions would mitigate for spread of noxious weeds. All machinery and vehicles would be power-

washed before traveling to the site, including an undercarriage wash. Disturbed areas would be seeded with a native seed mix.

Piscicide crews are another potential mode of spreading weeds. As with the heavy equipment, all vehicles would have an under carriage wash before driving to the project area. Drivers would avoid driving over weed-infested areas. If this is unavoidable, the vehicles would receive an undercarriage wash before driving to another part of the project area.

Cumulative Effects on Vegetation

All components, barrier construction and fish eradication and reintroduction would have minor, short-term effects on vegetation. The greatest disturbance would occur at the barrier construction site and a separate EA will provide detail on BMPs, reclamation, weed control, and mitigation. Trampling of vegetation by field crews is another disturbance; however, this would be short-term and minor as plants are resilient to this level of use. As no plant species of special concern are known to be present in the project area, no population level effects on rare species are likely. BMPs such as undercarriage washes would limit the spread of noxious weeds from vehicles transporting fieldworkers.

2.1.5 Fish and Wildlife

5. Fish and Wildlife	Impact				Can Impact be Mitigated?	Comment Index
Would the proposed action result in:	Unknown	None	Minor	Potentially Significant		
a. Deterioration of critical fish or wildlife habitat?		X				
b. Changes in the diversity or abundance of game animals or bird species?			X		Yes	5b
c. Changes in the diversity or abundance of nongame species?			X		Yes	5c
d. Introduction of a new species into an area?		X				5d
e. Creation of a barrier to the migration or movement of animals?			X		Yes	5e
f. Adverse effects on any unique, rare, threatened, or endangered species?		X				5f
g. Increase in conditions that stress wildlife populations or limit abundance (including harassment, legal or illegal harvest, or other human activity)?			X			5g
h. Would the project be performed in any area in which T&E species are present, and would the project affect any T&E species or their habitat? (Also see 5f)			X			5f
i. Would the project introduce or export any species not presently or historically occurring in the receiving location? (Also see 5d)		X				

Comment 5b: Changes in the Diversity or Abundance of Game Animals or Bird Species
The proposed action would eliminate hybrids of westslope cutthroat trout, Yellowstone cutthroat trout, and rainbow trout. Brook trout and brown trout are present in the South Fork Sixteenmile Creek drainage; however, they have never been captured in the project area (B.C. Roberts, personal communication, GNF). As a native fish restoration project, eliminating these fish species is the key objective of the project. Reestablishment of a nonhybridized population of westslope cutthroat trout would mitigate the loss of the existing hybrid fishery and should decrease justification for inclusion of westslope cutthroat trout for protection under the Endangered Species Act.

Game species such as mule deer (*Odocoileus hemionus*), moose (*Alces alces*), black bears (*Ursus americanus*), and mountain lions (*Felis concolor*) and several species of mountain grouse are likely present within the project area. Presence of field crews would temporarily displace these

species for the 2 to 3 day duration of the project. This would be a short-term disturbance and game species would return after completion of the piscicide project. The barrier construction portion would take several weeks resulting in longer displacement of game species. This effect would be short-term and minor. Neither action would result in harm to these species.

Comment 5c: Changes in the Diversity or Abundance of Nongame Species

Both components of this project would have effects on some nongame species. The barrier construction component would potentially displace wildlife during the 3-week construction period due to noise of heavy equipment. This displacement would be short-term and minor.

Piscicide treatment would have potential to result in temporary reductions in diversity and abundance of a variety of nongame wildlife species. Range maps, observation data, and field guide information housed by the MNHP[3] allowed determination of species likely to occur within the project area. In addition, the MNHP is a source of information on the habitats, food preferences, and life history strategies, which informed evaluation of potential effects. This section examines the risks to wildlife associated with direct exposure to rotenone, a diminished prey base relating to reduced biomass of fish or aquatic invertebrates, or exposure to rotenone through ingestion of dead animals or treated water.

Rotenone is highly toxic to fish, and treatment would have immediate effects on fish within the treatment area. Comment 6b addresses effects on game fish, which would be minor and temporary, as restocking would restore a population of nonhybridized westslope cutthroat trout. Mottled sculpin are present in the project area and longnose dace are present in South Fork Sixteenmile Creek, but have never been captured in the project area (B.C. Roberts, personal communication, GNF). If pretreatment monitoring, or presence of dead sculpin and dace during treatment, confirms their presence, they would be reintroduced from populations downstream. The action would be conducted under FWP's fish transfer policy (FWP 2012). The policy includes procedures designed to avoid disease transmission, prevent adverse effects on native species, and protect genetic diversity.

Gilled aquatic invertebrates are nontarget organisms with considerable potential to suffer negative effects from piscicide treatment. In streams, benthic populations of true flies, stoneflies, mayflies, and caddis flies would be the primary affected taxa. Owing to a number of factors, these effects would be short-term and temporary. Investigations into the effects of rotenone on benthic organisms indicate that rotenone results in temporary reduction of stream-dwelling invertebrates. In one case, no noteworthy reduction in aquatic invertebrates occurred despite concentrations of rotenone being twice as high as the proposed concentration (Houf and Campbell 1977). In other cases, invertebrates recovered quickly following treatment. For example, following piscicide treatment of a California stream, macroinvertebrates experienced

[3] http://mtnhp.org/

an “explosive resurgence” in numbers, with black fly larvae recovering first, followed by mayflies and caddis flies within six weeks after treatment (Cook and Moore 1969). Stoneflies returned to pretreatment abundances by the following spring. Another mitigative factor is that invertebrates that were most sensitive to rotenone also tended to have the highest rate of recolonization due to short life cycles (Engstrom-Heg et al. 1978). Although gill-respiring invertebrates are a sensitive group, many are far less sensitive to rotenone than fish (Schnick 1974; Chandler and Marking 1982; Finlayson et al. 2010). Because of their short life cycles (Anderson and Wallace 1984), good dispersal ability (Pennack 1989), and generally high reproductive potential (Anderson and Wallace 1984), aquatic invertebrates are capable of rapid recovery from disturbance (Boulton et al. 1992; Matthaei et al. 1996).

Drift and recolonization by aerial adults are the primary mechanisms of recovery, and several miles of stream upstream of the treatment area would provide a source of drifting invertebrates to treated waters. The relatively small amount of stream treated and proximity to source populations would further expedite this recovery. Moreover, treatment would occur following emergence of most invertebrates, so that much of the invertebrate community would be in a less vulnerable life history stage.

The well-established ability of macroinvertebrates to recover following disturbance, combined with the lower susceptibility of some taxa to rotenone, would contribute to rapid recovery of invertebrate populations. Disturbance is a common occurrence in streams and includes floods, wildfire, and human-caused alterations such as incompatible livestock grazing practices (Mihuc and Minshall 1995; Wohl and Carline 1996; Minshall 2003). These disturbances have greater potential to have long-term effects on stream-dwelling assemblages than piscicide treatments given changes in geomorphology, impairment of riparian health and function, and reduced water quality.

The MNHP’s list of species of special concern does not report any rare or unique invertebrates within the general area of the South Fork Sixteenmile Creek project, nor has monitoring in neighboring streams found any species of special concern. Numerous instances of pre-project sampling in fish bearing or fishless waters have never detected invertebrate species of special concern (D. Gustafson, personal communication, Montana State University). Non-fish bearing reaches within the watershed would not be treated, so invertebrates that have not coevolved with fish would not be affected.

Amphibians are closely associated with water, and have potential to be exposed to rotenone during treatment. Species with potential to be in the treatment area are the Columbian spotted frog (*Rana luteiventris*) and the western toad (*Bufo boreas*). Of these, the Columbian spotted frog has the greatest probability for exposure to rotenone, given its preference for streamside habitat. Western toads are less dependent on surface water, except for during the breeding season, so these species have a lower probability of encountering rotenone treated waters.

Applying rotenone to South Fork Sixteenmile Creek would likely have negligible, if any, effects on juvenile amphibians given the physical setting and proposed timing of piscicide application. Similar to other gill-bearing organisms, amphibian larvae are sensitive to rotenone, and exposure to rotenone at levels used to kill fish is acutely toxic to Columbian spotted frog larvae (Grisak et al. 2007). Although tadpoles may be vulnerable to rotenone, at least some species may be up to 10 times more tolerant than fish (Chandler and Marking 1982). Nonetheless, the potential for exposure would be minimal in South Fork Sixteenmile Creek, as this relatively high gradient mountain stream simply does not provide suitable slow water or lentic breeding habitat for frogs and toads. Likewise, treating the stream in early fall past the larval stage would prevent exposure in the event unidentified beaver ponds or other backwater features were present. Treatment in late summer or early fall is a recommended BMP to prevent effects on amphibians, as they would be past the gilled life history stage (Grisak et al. 2007).

Effects on adult amphibians would be insignificant given their low vulnerability to rotenone, mobility, and project timing. Adult Columbian spotted frogs do not suffer an acute response to trout killing concentrations of Prenfish, another commonly used formulation of rotenone that includes organic compounds (Grisak et al. 2007). Adult western toads would likely be less sensitive than frogs given their impermeable skin (Maxell and Hokit 1999). Moreover, adult toads and frogs have the ability to leave the aquatic environment, which substantially reduces the potential for exposure (Maxell and Hokit 1999).

Similar to invertebrates, Columbian spotted frogs show a prodigious ability to recolonize following piscicide treatment. A field study attests to the ability of Columbia spotted frogs to recover following application of CFT Legumine in a lake at the concentration proposed for this project (Billman et al. 2012). As expected, gill-respiring tadpoles suffered total mortality in the 24 hours following exposure. In contrast, non-gill breathing metamorphs, juveniles, and adults did not show any apparent response. Follow up monitoring showed that tadpoles repopulated all treated waters and their numbers were similar to, or higher than, pretreatment levels.

Implementation of a basic monitoring plan would allow evaluation of the short and long-term effects of piscicide treatment on potentially sensitive taxa. The macroinvertebrate sampling component would involve sampling macroinvertebrates using standard operating procedures developed by DEQ. Sample collection will occur before piscicide treatment at two locations in South Fork Sixteenmile Creek and would be repeated two weeks after treatment, then for two years afterward. Fish recovery would be evaluated using electrofishing over the course of 5 years. A survey of birds, reptiles, amphibians, and mammals would take place before treatment and would be repeated in each of the following two years. FWP would be responsible for implementing the monitoring.

A temporary reduction in prey of aquatic origin has potential to influence mammals, amphibians, reptiles, birds, and bats. The American mink is the mammalian predator on fish that is most

likely to occur in the project area. Mink are opportunistic predators and scavengers, with fish and invertebrates comprising a portion of their diet. Therefore, the reduction in density of fish following treatment may displace mink to adjacent, untreated reaches until fish populations recover. Nonetheless, as opportunists, American mink have flexibility to switch to other prey species.

Other mammalian predators may experience short-term and minor consequences. Opportunistic black bears (*Ursus americanus*), raccoons (*Procyon lotor*), red foxes (*Vulpes vulpes*), coyotes (*Canis latrans*), and striped skunks (*Mephitis mephitis)* would likely consume dead fish immediately after piscicide treatment. The temporary reductions of aquatic prey, and the brief availability of dead fish, constitute short-term and minor effects on mammalian predators and scavengers.

A number of bird species with potential to occur within the project area consume fish or invertebrates with an aquatic life history stage. The belted kingfisher (*Megaceryle alcyon*) consumes fish as its primary food source. The American dipper (*Cinclus mexicanus*) forages for aquatic invertebrates in mountain streams year round. Numerous species of songbird eat winged adults of invertebrates originating from streams. The effect of a reduction of forage base on these organisms would be minor and short-term. Belted kingfishers may be temporarily displaced from the project area, until westslope cutthroat trout rebound in South Fork Sixteenmile Creek. As rotenone does not affect all aquatic invertebrates, some invertebrate prey would remain to support American dippers, although some level of displacement is possible. Follow up monitoring in Lower Deer Creek, one year post-treatment found American dippers at similar numbers as before treatment, presence of numerous juvenile birds, and location of a new dipper nest within the project area (C.L. Endicott, personal communication, FWP). Songbirds that consume invertebrates would still have access to insects of terrestrial origin. In addition, many songbird species would have migrated during the treatment period.

Two species of gartersnake, the common gartersnake (*Thamnophis sirtalis*) and the terrestrial gartersnake (*T. elegans*), likely occur along South Fork Sixteenmile Creek, and a reduction in aquatic based food may affect these snakes, although these species are generalists and would still have forage from terrestrial sources. Similarly, the Columbian spotted frog regularly forages along stream margins. Effects on these reptile and amphibian predators would likely be short-term and minor, with temporary displacement or reductions in population size. On Lower Deer Creek, terrestrial gartersnakes consumed juvenile fish killed by rotenone. This boon was likely beneficial as it allowed building up of body reserves just before hibernation. Given the quick recovery expected of the fish and invertebrate prey base, gartersnakes would not experience long-term or significant effects.

Bats also consume winged insects, and therefore, rotenone projects have potential to have a negative effect on bats. Diet preferences and seasonal habitat use for bats in the project area

indicate effects on bats would be negligible. Bat species that may occur in the project area consume mostly invertebrates of terrestrial origin. Because of the rapid recovery of aquatic invertebrates, and a lack of reliance on invertebrates of aquatic origin, bats would experience no adverse effects from piscicide treatment in South Fork Sixteenmile Creek.

Ingestion of rotenone, either from drinking water, or from consuming dead fish or invertebrates, is a potential route for rotenone exposure. A substantial body of research has investigated the effects of ingested rotenone in terms of acute and chronic toxicity, and other potential health effects. An important consideration in reviewing these studies is that most examined laboratory exposure to exceptionally high concentrations of rotenone that would be unattainable under proposed field application. The low level of effects at these super-elevated concentrations indicates risks to wildlife from exposure to proposed levels would be minor and short-lived, if wildlife experienced any effects from ingesting treated water or dead fish and invertebrate.

In general, ingestion does not affect mammals because of digestive action in their stomach and intestines (AFS 2002). Investigations examining the potential for acute toxicity from ingesting rotenone find mammals would need to consume impossibly high amounts of rotenone-treated water or rotenone-killed animals for a lethal dose. For example, a 22-pound dog would have to drink nearly 8,000 gallons of treated water within 24 hours, or eat 660,000 pound of rotenone-killed fish within a day to receive a lethal dose (CDFG 1994). A half-pound mammal would need to consume 12.5 mg of pure rotenone, or drink 66 gallons of water for a lethal dose (Bradbury 1986). In comparison, the effective concentration of rotenone to kill fish is 0.025 to 0.05 ppb, which is considerably lower than concentrations resulting in acute toxicity to mammals.

Evaluations of potential exposure of mammals relating to exposure from scavenging indicate acute toxicity from ingesting rotenone-killed fish is highly unlikely (EPA 2007). Estimation of the daily consumption of dead fish by an “intermediate-sized mammal” of 350 mg, which is about half the size of a male American mink, found an estimated daily dose of 20.3 µg of rotenone. This is well below the median lethal dose of 13,800 µg of rotenone for a mammal of that size. A “large mammal” is one with 1,000 g body weight, which is within the weight range for female American mink. If this size mammal fed exclusively on fish killed by rotenone, it would receive an equivalent daily dose of 37 µg of rotenone. In comparison, the estimated median lethal concentration of rotenone for a 1,000 g mammal was 30,400 µg, which is over 800 times the daily dose. The EPA (2007) concluded that piscivorous mammals were highly unlikely to consume enough fish to result in acute toxicity.

Chronic toxicity associated with availability of dead fish over time would not pose a threat to mammals, nor would other health effects be likely. Rats and dogs fed high levels of rotenone for six months to two years experienced only diarrhea, decreased appetite, and weight loss (Marking 1988). The unusually high treatment concentrations did not cause tumors or reproductive problems. Toxicology studies investigating potential secondary effects to rotenone exposure

have found no evidence that it results in birth defects (HRI 1982), gene mutations (BRL 1982; Van Geothem et al. 1981), or cancer (Marking 1988). Rats fed diets laced with 10 to 1000 ppm of rotenone over a 10-day period did not experience any reproductive dysfunction (Spencer and Sing 1982). Furthermore, fish decay rapidly following piscicide treatment and the rotenone breaks down rapidly, so chronic exposure would not occur.

Concerns over putative links to Parkinson's disease often emerge in response to potential rotenone projects. This issue relates to a study in which rats injected with rotenone for up to 2 weeks showed lesions characteristic of Parkinson's disease (Betarbet et al. 2000). Review of the methodology employed in this study finds no similarities to fisheries related piscicide projects in terms of dose, duration of exposure, or mode of delivery. The rats received constant injection of rotenone and dimethyl sulfoxide directly into their bloodstream, resulting in continuously high concentrations of rotenone. The purpose of the dimethyl sulfoxide was to enhance tissue penetration of the rotenone, as normal routes of exposure actually slow introduction of chemicals into the bloodstream. In contrast, field exposure would involve far lower concentrations of rotenone, without the synergistic effects of dimethyl sulfoxide to promote uptake into tissues. Moreover, the rapid breakdown of rotenone in the environment would not support more than a few days of potential exposure from ingesting water or dead animals. Finally, continuous intravenous injection in no way resembles any potential mode of field exposure to rotenone, which would be ingestion of dilute rotenone in water, or consumption of fish or invertebrates killed by rotenone. As the injection study does not provide a model for potential effects of field application of rotenone, and other researchers have not found Parkinson's-like effects in exposed animals (Marking 1988), FWP concluded that rotenone application would not result in neurological risks to field exposed animals.

Birds may also scavenge dead fish and invertebrates, or ingest treated water; however, research on toxicity of rotenone to birds indicates acute toxicity was not possible from field application of rotenone to achieve a fish kill. In general, birds require concentrations of rotenone at least 1,000 to 10,000 times greater than is required for lethality in fish (Skaar 2001). Chickens, pheasants, and related gallinaceous birds are resistant to rotenone, and four-day-old chicks are more resistant than adults (Cutkomp 1943). Rotenone is slightly toxic to waterfowl, although acute toxicity occurs at levels 2,000 times higher than the proposed treatment concentration (Ware 2002).

Evaluation of the risks to scavenging birds based on estimated daily dose and body size indicated no risk of acute toxicity from eating rotenone-killed fish (EPA 2007). The daily dose of rotenone from consumption of scavenged fish ranged from 15 µg to 95 µg. At this level of contamination, a raven-sized bird would need to consume from 43,000 to 274,000 dead fish in one day for a lethal dose.

Observations of terrestrial gartersnakes consuming piscicide killed fish on Lower Deer Creek, near Big Timber, Montana, indicates reptiles have potential to be exposed to rotenone by scavenging or drinking water. Although no studies on the effect of consumption of rotenone-killed organisms on reptiles is available, snakes are likely highly invulnerable to a toxic effect. A snake's digestive system breaks down bone, fur, scales, and exoskeletons, and can likely handle the highly reactive and fragile rotenone molecule. Furthermore, the exposure concentrations are so low as to not affect other non-gill breathing organisms, suggesting snakes would have similar tolerance.

In summary, effects on nontarget species of wildlife would range from nonexistent to short-term and minor. Fish and benthic invertebrates would suffer total to some mortality; however, restocking and natural recovery would result in these effects being temporary. Some species may experience temporary reductions in prey base, which may displace these animals until fish and macroinvertebrate populations rebound. Concentrations of rotenone in water and dead fish would be thousands of times less than levels causing acute and chronic toxicity to animals ingesting treated water or dead fish. Moreover, as rotenone degrades rapidly, the duration of potential exposure would be short, measurable in days, which would not pose long-term threats to wildlife.

Comment 5d: Introduction of a New Species into an Area

This project would return nonhybridized westslope cutthroat trout to South Fork Sixteenmile Creek and its tributaries.

Comment 5e: Creation of a Barrier to the Movement or Migration of Animals

A separate component of this project would include construction of a barrier to prevent upstream movement of fish into the project area in order to secure a reestablished population of westslope cutthroat trout. As blocking reinvasion of nonnatives and hybrids into the project is the objective, this consequence is desirable. The GNF's draft decision memo will provide more detail on barriers and movements of animals.

Another concern regarding the barrier is the inability of westslope cutthroat trout passing over the barrier to return to the project area. Several factors indicate this would be minor effect of westslope cutthroat trout. Biologists working with this fish have observed that nonhybridized westslope cutthroat trout rarely move downstream (D. Moser, FWP, personal communication). Moreover, nearly all the remaining populations of westslope cutthroat trout east of the divide exist because a barrier protects the population from nonnative fishes (see Figure 5 for an example from the Bob Marshall Wilderness). Barriers are a natural part of the landscape and are the primary reason we have any nonhybridized westslope cutthroat trout east of the Continental Divide.

Comment 5f: Effects on Unique, Rare, Threatened, or Endangered Animals

The MNHP database[4] lists 7 animal species of special concern as occurring in the township and range within the project area (Table 4). Field guide information provided by the MNHP website allows inference on potential effects of the project on these species. Evaluation of their habitat needs, forage base, and migration timing suggests effects on these species would be negligible or beneficial.

Table 4: Animal species of special concern known to occur in the township and range in which the South Fork Sixteenmile Creek project lies (MNHP database).

Group	*Scientific Name*	*Common Name*	*Global Rank*	*State Rank*	*USFS*
Mammals	*Gulo gulo*	Wolverine	G4	S3	Sensitive
Mammals	*Lasiurus cinereus*	Hoary bat	G5	S3	
Birds	*Oreoscoptes montanus*	Sage thrasher	G5	S3B	
Birds	*Spizella breweri*	Brewer's sparrow	G5	S3B	
Birds	*Nucifraga Columbia*	Clark's nutcracker	G5		
Birds	*Strix nebulosa*	Great gray owl	G5	S3	
Fish	*Oncorhynchus clarkii lewisi*	Westslope cutthroat trout	G4T3	S2	Sensitive

G4 or S4: uncommon but not rare (although it may be rare in parts of its range), and usually widespread
G3 or S3: Potentially at risk because of very limited and/or declining numbers, range, and/or habitat, making it vulnerable to global extinction or extirpation in the state.
G5 or S5 Common, widespread, and abundant (although it may be rare in parts of its range). Not vulnerable in most of its range.
portion of its range (16 U.S.C 1532[20]).
G2 or S2: At risk because of very limited and/or declining numbers, range, and/or habitat, making it vulnerable to global extinction or extirpation in the state
T: Infraspecific taxon (trinomial) – the status of infraspecific taxa (subspecies or variety) are indicated by a "T-rank" followed by the species' global rank

Wolverines have a small potential to be within the project area. Observations of wolverines have occurred within the general area within the past 10 years (Montana Natural Heritage Field Guide). Their density in the area is likely to be low, with few observations reported. Wolverines occupy alpine areas, and coniferous or boreal forests. They typically have large home ranges and low densities – typically 1 per 25 square miles. South of the boreal forest, most habitats descriptions in the literature are in accordance with Groves (1988) who described their habitat as being "large, mountainous, and essentially roadless areas."

Project activities, including piscicide application and barrier construction, would be short-term and minor, or result in no effects on wolverines. Given their tendency to be wide-ranging, temporary displacement, in the event they wander into the project area, would result in leaving a small portion of their home range. Moreover, wolverines are likely to avoid the area, as a road follows the main stem of South Fork Sixteenmile Creek along much of its length.

[4] http://mtnhp.org/default.asp

Hoary bats are another species of special concern that may occur within the project area, as a few observations of them in the general area exist. Hoary bats are migratory and present in Montana in forested areas during the summer. Their diet includes a wide-range of primarily terrestrial winged-invertebrates, although they consume some invertebrates with an aquatic life-history stage. The piscicide treatment has the potential to decrease availability of aquatic-dependent invertebrates for a few days, although invertebrate populations rebound quickly. Observations of an impressive caddis fly and midge emergence event in Lower Deer Creek one day following two days of piscicide treatment (C. L. Endicott, personal communication, FWP) indicates some taxa or life history stages are not susceptible to piscicide and would be available. As hoary bats roost during the day, fieldworkers would be unlikely to disturb this species during piscicide treatment.

Sage thrashers and Brewer's sparrows were among the species special of concern that occur in the sections in which the project lies. As their name suggests, sage thrashers reside in sagebrush steppe, not a montane environment like South Fork Sixteenmile Creek. Likewise, Brewer's sparrows are a grassland dwelling species and would be highly unlikely to occur in or close to the project area.

Clark's nutcracker is another species of special concern likely to occur in the project area. Their status as a species of special concern relates to declines in pines (*Pinus* spp.), particularly cold-climate species, such as white-bark pine (*P. albicaulus*), which are decreasing in distribution because of parasites, disease, and climate change. The large seeds of these pine species provide the bulk of the Clark's nutcrackers diet, although they will also feed on insects, berries, small mammals and carcass flesh. During and after treatment, Clark's nutcrackers may consume some fish or invertebrate carcasses; however, as described in Comment 2a: Alterations in Water Quality, opportunistic scavenging on dead fish, invertebrates, or both would not result in a dose that would result in toxicity or bioaccumulation.

With regard to disturbance from occupied habitat during piscicide treatment or barrier construction, human activities are unlikely to have significant effect on Clark's nutcrackers. This species is tolerant of humans and is among the members of the crow family referred to as "camp robbers."

The great gray owl is another species of special concern likely to occur in the project area. The MNHP reports infrequent sightings of this large owl near the project area. No systematic surveys for great gray owls have occurred in Montana and little specific habitat information exists. They do occupy coniferous forest, so project activities have potential to influence great gray owls, primarily presence of humans during piscicide treatment and during the barrier construction. Nonetheless, great gray owls show surprising tolerance to the presence of humans. In March of 2013, a great gray owl occupied trees in the park adjacent to the Bozeman Public Library and an extensive trail system for an entire week (Bozeman Daily Chronicle, March 21, 2013). Its

presence drew hundreds of observers per day, yet the owl remained for a week, likely attracted to the abundance of mice and voles in the area. Their inclusion as a species of special concern relates to how forest activities across the landscape may affect their habitat.

The westslope cutthroat trout is another species of special concern within the general area of the project, although core or conservation populations do not occur within the project area. This project would be beneficial to westslope cutthroat trout, as its goal is to reestablish a nonhybridized population within historically occupied habitat. This goal is consistent with the MOU for westslope cutthroat trout conservation (MCTSC 2007) and the *Statewide Fisheries Management Plan* (FWP 2013).

Comment 5g: Increase in Conditions That Would Stress Wildlife
See Comment 5b: Changes in the Diversity or Abundance of Game Animals or Bird Species and Comment 5c: Changes in the Diversity or Abundance of Nongame Species.

Cumulative Effects on Fish and Wildlife
Evaluation of the potential cumulative effects on fish and wildlife indicates these would be short-term and temporary, and include temporary displacement during piscicide treatment. This conclusion holds for species of special concern, in which temporary displacement would be the primary impact, although as roads parallel much of the stream, disturbance from vehicles and humans is already common. Fish and some aquatic invertebrates would experience considerable mortality. Macroinvertebrates would recolonize through natural mechanisms. Reintroduction of westslope cutthroat trout would mitigate for the loss of the existing fishery. Reintroduction of other native species would likewise mitigate for their loss during piscicide treatment. Westslope cutthroat trout would benefit as the goal of the project is to reestablish a population of nonhybridized fish within its historic range.

2.2 Human Environment

2.2.1 Noise and Electric Effects

6. Noise and Electric Effects	**Impact**				**Can Impact be Mitigated?**	**Comment Index**
Would the proposed action result in:	**Unknown**	**None**	**Minor**	**Potentially Significant**		
a. Increases in existing noise levels?			X			6a
b. Exposure of people to nuisance noise levels?		X				
c. Creation of electrostatic or electromagnetic effects that could be detrimental to human health or property?		X				
d. Interference with radio or television reception?		X				

Comment 6a: Increases in Existing Noise Levels

Field crews during piscicide treatment and the use of heavy equipment during barrier construction would increase noise levels. The increased noise from field crews would be short-term and of low magnitude. The EA under preparation for barrier construction will address increases in noise and mitigative actions.

2.2.2 Land Use

7. Land Use	Impact				Can Impact be Mitigated?	Comment Index
Would the proposed action result in:	Unknown	None	Minor	Potentially Significant		
a. Alteration of or interference with the productivity or profitability of existing land use of an area?		X				7a
b. Conflict with a designated natural area or area with unusual or scientific importance?		X				
c. Conflict with any existing land use whose presence would constrain or potentially prohibit the proposed action?			X		No	7c
d. Adverse effects on, or relocation of, residences?						

Comment 7a: Conflicts with Existing Land Uses

The proposed action would replace a hybrid trout fishery with a nonhybridized, native population of westslope cutthroat trout. The existing hybrid fishery is currently managed under catch and release regulations. In addition, USFS allotment management plans recognize South Fork Sixteenmile Creek as a westslope cutthroat trout population. As a result, no change in use of natural resources would occur due to the proposed action. Any future modification of allotment management plans would be because of management decisions unrelated to the genetic purity of westslope cutthroat trout in South Fork Sixteenmile Creek.

Comment 7c: Conflict with Existing Land Use

The proposed barrier project, piscicide treatments, and stocking efforts would be initiated consecutively. Barrier construction would be initiated after spring runoff (sometime after June 15th). Construction activities (excavator operation, dewatering, etc.) would likely reduce recreational aesthetics for two to three weeks. Because of the complexity and size of this project and the potential for unseasonable weather, construction activities may extend into archery season (September), although this is unlikely. The location of the proposed barrier is near the terminus of a national forest system road. In addition, there are no trailheads located near the barrier site.

During treatment with rotenone, there would be increased personnel activity in the South Fork Sixteenmile Creek drainage. The label for CFT Legumine states that detoxification should be terminated when replenished fish survive and show no signs of stress for at least four hours. Experience has shown treated water to be nontoxic to fish in 24 to 48 hours after the application of rotenone. Therefore, the duration of personnel within the treatment area would last 3 to 4 days. The treatment would occur in late summer or early fall. At proposed treatment levels, stream water would not be toxic to wildlife or livestock. However, to limit any potential conflict, the treatment would occur when livestock are pastured elsewhere or livestock would be temporarily moved to adjacent pastures during the treatment period.

Cumulative Effects

Effects on land use from the proposed actions and the associated barrier construction would be short-term, minor, and consecutive. Barrier construction would reduce the outdoor aesthetic and may displace game animals. Piscicide treatment would temporarily remove fish and result in lower densities until the westslope cutthroat trout rebound. By starting the project early in the summer, we are attempting to finish all components before the onset of hunting season. Nonetheless, unforeseeable factors may delay one or more components of the project.

2.2.3 Risks/Health Hazards

8. Risks/ Health Hazards	**Impact**				**Can Impact be Mitigated?**	**Comment Index**
Would the proposed action result in:	**Unknown**	**None**	**Minor**	**Potentially Significant**		
a. Risk of an explosion or release of hazardous substances (including, but not limited to oil, pesticides, chemicals, or radiation) in the event of an accident of other forms of disruption?			X			8a
b. Affect an existing emergency response or emergency evacuation plan or create a need for a new plan?			X			8b
c. Creation of any human health hazard or potential hazard?			X			See 8a and 8c
d. Would any chemical piscicides be used?			X			8a

Comment 8a: Risk of Explosion of Release or Hazardous Substances

FWP and GNF fieldworkers applying piscicide would have the principal risk relating to exposure to hazardous materials. Following the exposure controls and other protective measures detailed in the MSDSs would result in protection of the safety and health of applicators. Protective gear and equipment include the use of respirators when using undiluted CFT Legumine. All applicators would wear personal protective equipment as required by label instructions.

The $KMnO_4$ applicators would also require protective clothing and gear to control exposure. Personal protection required in the MSDS includes gloves, splash goggles, synthetic apron, and vapor and dust respirator. In addition, $KMnO_4$ can explode when organic or other readily oxidizable substances. Applicators would ensure $KMnO_4$ is not exposed to these substances.

Field application would occur under the supervision of at least one, but most likely several licensed pesticide applicators. All individuals handling or applying chemical would receive training before the treatment. Materials would be transported, handled, applied, and stored according to the label specifications

Comment 8b: Affect an Existing Emergency Response Plan.

FWP requires a treatment plan for rotenone projects. This plan addresses many aspects of safety for people who are on the implementation team such as establishing a clear chain of command, training, delegation and assignment of responsibility, clear lines of communication among members, spill contingency plans, first aid, emergency responder information, personal protective equipment, monitoring and quality control. Implementing this project should not require modifications of existing emergency plans. Because FWP has developed an implementation plan, the risk of the need for an emergency response is minimal and any effects on existing emergency responders would be short-term and minor.

Comment 8c: Creation of any Human Health Hazard

Risks to human health relate to exposure to rotenone, the inert ingredients in the CFT Legumine formulation, or $KMnO_4$ used in detoxifying rotenone. Information examined here includes an analysis of human health risks relating to rotenone exposure (EPA 2007), MSDS sheets for chemicals used, and an evaluation of the chemical constitution of the CFT Legumine formula (Fisher 2007).

Acute toxicity refers to the adverse effects of a substance from either a single exposure or multiple exposures in a short space of time. Rotenone ranks as having high acute toxicity through oral and inhalation routes of exposure, and low acute toxicity through exposure to skin (EPA 2007). Examination of acute toxicity profiles compiled by the EPA (2007) indicates this high acute toxicity would be applicable to undiluted CFT Legumine, with median lethal doses for rats ranging from 39.5 mg/kg for female rats, and 102 mg/kg for male rats. In contrast, the proposed concentration for rotenone in surface water is 0.025 ppb to 0.05 ppb. Therefore, field applicators would take necessary precautions to prevent ingestion or inhalation of undiluted CFT Legumine to avoid exposure to toxic concentrations of rotenone. Using a liquid formulation as opposed to powder would reduce any risks associated with inhalation. Exposure to concentrations in surface water would not lead to toxicity, although only approved field personnel would be near the stream during treatment as an added protection.

Table 5: Toxicological endpoints for rotenone (EPA 2007).

Exposure Scenario	Dose Used in Risk Assessment, Uncertainty Factor (UF)	Level of Concern for Risk Assessment	Study and Toxicological Effects
Acute Dietary (females 13-49)	NOAEL = 15 mg/kg/day UF = 1000 aRfD = 15 mg/kg/day = 0.015 mg/kg/day 1000	Acute PAD = 0.015 mg/kg/day	Developmental toxicity study in mouse (MRID 00141707, 00145049) LOAEL = 24 mg/kg/day based on increased resorptions
Acute Dietary (all populations)	An appropriate endpoint attributable to a single dose was not identified in the available studies, including the developmental toxicity studies.		
Chronic Dietary (all populations)	NOAEL = 0.375 mg/kg/day UF = 1000 cRfD = 0.375 mg/kg/day = 0.0004 mg/kg/day 1000	Chronic PAD = 0.0004 mg/kg/day	Chronic/oncogenicity study in rat (MRID 00156739, 41657101) LOAEL = 1.9 mg/kg/day based on decreased body weight and food consumption in both males and females
Incidental Oral Short-term (1-30 days) Intermediate-term (1-6 months)	NOAEL = 0.5 mg/kg/day	Residential MOE = 1000	Reproductive toxicity study in rat (MRID 00141408) LOAEL = 2.4/3.0 mg/kg/day [M/F] based on decreased parental (male and female) body weight and body weight gain
Dermal Short-, Intermediate-, and Long-Term	NOAEL = 0.5 mg/kg/day 10% dermal absorption factor	Residential MOE = 1000 Worker MOE = 1000	Reproductive toxicity study in rat (MRID 00141408) LOAEL = 2.4/3.0 mg/kg/day
Inhalation Short-term (1-30 days) Intermediate-term (1-6 months)	NOAEL = 0.5 mg/kg/day 100% inhalation absorption factor	Residential MOE = 1000 Worker MOE = 1000	[M/F] based on decreased parental (male and female) body weight and body weight gain
Cancer (oral, dermal, inhalation)	Classification; No evidence of carcinogenicity		

UF = uncertainty factor, NOAEL = no observed adverse effect level, LOAEL = lowest observed adverse effect level, aPAD = acute population adjusted dose, cPAD = chronic population adjusted does, RfD = reference dose, MOE = margin of exposure, NA = Not Applicable

As rotenone degrades, it breaks down into degradation products including rotenoloids. The EPA considered the toxicity of these compounds, and determined that because of their structural similarities to rotenone, the degradation products are no more toxic than the parent compound.

Dietary risks considered threats to the subgroup "females 13-49 years old," and examined exposure associated with consuming exposed fish and drinking treated surface water. In determining potential exposure from consuming fish, the EPA used maximum residues in fish tissue. The concentrations of residue considered were conservative, meaning they may have been an overestimate of the rotenone concentrations in muscle tissue, as they included non-edible tissues, where concentrations may be higher. The EPA concluded that acute dietary exposure estimates resulted in a dietary risk below the EPA's level of concern; therefore, consumption of fish killed by rotenone does not present an acute risk to the sensitive subgroup.

The EPA considered chronic dietary risks relating to exposure through drinking water. Chronic exposure from consuming exposed fish was not evaluated, given rotenone's rapid degradation and low propensity to bioaccumulate in fish. Based on the chronic toxicity endpoint, the drinking water level of concern was 40 ppb (µg/L), which addressed effects on infants and children, the most sensitive population subgroup. The effective concentration for fish eradication is 0.025 ppb to 0.05 ppb.

In evaluating the potential for chronic exposure to rotenone, the EPA acknowledged the rapid degradation of rotenone in the environment, and that expediting deactivation with oxidizing agents, such as $KMnO_4$, was a standard procedure in many projects. The EPA concluded that no chronic exposures to rotenone would occur where water is treated with $KMnO_4$ or subject to an oxidative water treatment regime. They further concluded that persistence of chronic or sub-chronic exposures to 40 ppb for several weeks was limited to specific circumstances, such as drinking water intakes in cold-water lakes where no oxidative water treatment occurred. In South Fork Sixteenmile Creek, treatment with $KMnO_4$ and natural breakdown would not present a risk to infants and children. Moreover, these surface flows are not used for domestic water sources, so potential for humans to consume treated water is exceptionally low.

The EPA estimated recreational risks associated with swimming, which would entail skin contact and incidental ingestion. The effective concentration of rotenone within South Fork Sixteenmile Creek would be considerably lower than thresholds for dermal contact or incidental ingestion. Nonetheless, signs at access points would alert recreationist to the presence of rotenone for the 3 to 4 days of treatment and restrictions on public access to the stream would provide an additional safety measure.

An aggregate risk is the combined risk from dietary exposure and non-occupational sources, such as residential and recreational exposure. In its evaluation of the aggregate risk, the EPA combined the risk of eating treated fish and drinking treated water, and concluded the risk does

not exceed their level of concern. The EPA did not aggregate recreational risk with the dietary risk, as the dietary assessment is conservative, and recreational exposure would be intermittent and would not occur for the general population. Moreover, stream closings, detoxification, and project timing would minimize or eliminate the potential for recreational exposure.

Occupational risks relate to fieldworkers mixing and applying rotenone. The EPA (2007) calculated margins of exposure for handlers mixing and applying rotenone through various methods, and with varying levels of protective gear, from none, to use of gloves, respirators, and protective clothing. The proposed approaches for this project call for use of a liquid formula applied with drip stations or backpack sprayer of seeps, springs, and backwaters (should they occur). Dough balls with powdered rotenone may be used in some places. The margins of exposures for these applications are below the level of concern with the use of gloves. Requiring protective eyewear, protective clothing, and respirators for applicators mixing rotenone would be highly protective of the health of applicators in the field.

The proposed formula for this project is CFT Legumine, which contains 5% rotenone, and 95% inert ingredients. Fisher (2007) evaluated the chemical composition of the inert fraction, the persistence of these constituents, and the potential to have an effect on human health and the environment. Comment 2a: Alterations in Water Quality (see page 22) details these findings. In general, the inert ingredients do not pose a threat to human health given their low toxicity and short period of persistence in the environment.

A recent study linked the use of rotenone and paraquat with the development of Parkinson's disease (PD) in humans later in life (Tanner et al. 2011). The after-the-fact study included mostly farmers from 2 states within the United States who presumably used rotenone for terrestrial application to crops and/or livestock. Rotenone is no longer approved for agricultural uses and is only approved for aquatic application as a piscicide.

The results of epidemiological studies of pesticide exposure are highly variable (Guenther et al. 2011). A series of studies have found no correlations between pesticide exposure and PD (Jiménez-Jiménez et al.1992; Hertzman 1994; Engel et al. 2001; Firestone et al. 2010). In contrast, some have found correlations between pesticide exposure and PD (Hubble et al. 1993; Lai et al. 2002; Tanner et al. 2011) and some have found it difficult determine which pesticide or pesticide class is implicated if associations with PD occur (Engel et al. 2001; Tanner et al. 2009). Criticisms of epidemiological studies linking pesticide exposure to PD relate to the high variation among study results, generic categorization of pesticide exposure scenarios, questionnaire subjectivity, and the difficulty in evaluating the causal factors in the complex disease of PD, which may have multiple causal factors, such age, genetics, or environment (Raffaele et al. 2011).

A specific concern is the inability to assess the degree of exposure to certain chemicals, including rotenone, particularly the concentration of the chemical, frequency of use, application, specific use, and exposure routes (Raffaele et al. 2011). Tanner et al. (2011) provides no information on formulation of rotenone used (powder or liquid) or the frequency or dose farmers were exposed to during their careers. This study also lacks data on the personal protective equipment used or any information about other pesticides farmers were exposed to during the period of the study is available. Without information on how much rotenone individuals were exposed to and for how long, evaluating the potential risk to humans of developing Parkinson's disease from aquatic applications of rotenone products is difficult.

An exhaustive review of the risks to human health of rotenone use as a piscicide concluded the following: "To date, there are no published studies that conclusively link exposure to rotenone and the development of clinically diagnosed PD. Some correlation studies have found a higher incidence of PD with exposure to pesticides among other factors, and some have not. It is very important to note that in case-control correlation studies, causal relationships cannot be assumed and some associations identified in odds-ratio analyses may be chance associations. Only one study (Tanner et al. 2011) found an association between rotenone and paraquat use and PD in agricultural workers, primarily farmers. However, there are substantial differences between the methods of application, formulation, and doses of rotenone used in agriculture and residential settings compared with aquatic use as a piscicide, and the agricultural workers interviewed were also exposed to many other pesticides during their careers. Through the EPA re-registration process of rotenone, occupational exposure risk is minimized by: new requirements that state handlers may only apply rotenone at less than the maximum treatment concentrations (200 ppb), the development of engineering controls to some of the rotenone dispensing equipment, and requiring handlers to wear specific PPE" (Guenther et al. 2011).

Clearly, reducing or eliminating risks to human health, including any potential risk of developing Parkinson's disease, public exposure to rotenone treated water must be eliminated to the extent possible. To reduce the potential for exposure of the public during the proposed use of CFT Legumine to restore westslope cutthroat trout, areas treated with rotenone would be closed to public access during the treatment. Signs would be placed at access points informing the public of the closure and the presence of rotenone treated waters. Personnel would be onsite to inform the public and escort them from the treatment area should they enter. Rotenone treated waters would be contained to the proposed treatment areas by over 1 mile of dry channel and if necessary, adding $KMnO_4$ to the stream at the downstream end of the treatment reach, either at the fish barrier or downstream where the stream re-surfaces. $KMnO_4$ would neutralize any remaining rotenone before leaving the project area. The efficacy of the neutralization would be monitored using fish, which are extremely sensitive species to the chemical and a hand held chlorine meter. Therefore, the potential for public exposure to rotenone treated waters is minimal. The potential for exposure would be greatest for those government workers applying

the chemical. To reduce their exposure, all CFT Legumine label mandates for personal protective equipment would be adhered to (see Comment 8a).

Finally, a description of the traditional uses of rotenone by native people is informative in evaluating its potential for creating hazards to human health. Native Brazilians have considerable exposure to rotenone through their use of this piscicide as a means to obtain fish for consumption (Teixera et al. 1984). They extract rotenone from the roots of the *Timbo* plant, and distribute the pulp by swimming into fish-bearing waters. Despite this high level of dermal and dietary exposure to rotenone, no harmful effects were apparent from this centuries old practice. Moreover, in contrast to the use of rotenone in fisheries management programs, the traditional method of applying rotenone from root does not involve protective measures, controlled concentrations of rotenone, nor detoxification with $KMnO_4$.

Cumulative Effects

Several actions would reduce the risks on human health. First, applicators handling the liquid rotenone formulation or $KMnO_4$ would follow all label instructions, including adhering to label requirements for concentration applied and the use of protective gear. An emergency plan would limit any risks associated with spills or exposure to chemicals. Detoxifying the rotenone with $KMnO_4$ would limit the spatial scope of the treated water. Fieldworkers operating drip stations would use protective gear such as eye protection and protective gloves. Posting signs alerting recreationalists about the project, and instructing them to avoid contact with the water, or drinking the water, would decrease the miniscule risk associated with dermal exposure or consumption.

2.2.4 Community Impact

9. Land Use	**Impact**				**Can Impact be Mitigated?**	**Comment Index**
Would the proposed action result in:	**Unknown**	**None**	**Minor**	**Potentially Significant**		
a. Alteration of or interference with the productivity or profitability of existing land use of an area?		X				
b. Conflict with a designated natural area or area with unusual or scientific importance?		X				
c. Conflict with any existing land use whose presence would constrain or potentially prohibit the proposed action?		X				
d. Adverse effects on, or relocation of, residences?		X				

2.2.5 Public Services/Taxes/Utilities

10. Public Services/Taxes/Utilities	Impact				Can Impact be Mitigated?	Comment Index
Would the proposed action result in:	Unknown	None	Minor	Potentially Significant		
a. Will the proposed action have an effect upon or result in a need for new or altered governmental services in any of the following areas: fire or police protection, schools, parks/recreational facilities, roads or other public maintenance, water supply, sewer or septic systems, solid waste disposal, health, or other governmental services? If any, specify: _____		X				10a
b. Will the proposed action have an effect upon the local or state tax base and revenues?		X				10b
c. Will the proposed action result in a need for new facilities or substantial alterations of any of the following utilities: electric power, natural gas, other fuel supply or distribution systems, or communications?		X				
d. Will the proposed action result in increased used of any energy source?		X				
e. Define projected revenue sources		X				
f. Define projected maintenance costs		X				

Comment 10a and 10b:

This project would not result in a need for new or altered governmental services or increase taxes for the construction or maintenance. Much of the expense for the project come from competitive grants earmarked for fish conservation. The labor involved by agency personnel is part of the job description of existing employees.

Not proceeding with the project would increase justification for federal government involvement in fish conservation. Lawsuits are likely, especially if FWP is unable to meet its conservation goals for westslope cutthroat trout. The result could be including westslope cutthroat trout for protection under the Endangered Species Act. Listing westslope cutthroat trout would reduce the flexibility landowners have in managing their properties and agricultural operations. Moreover, the federal government would likely need to hire additional personnel to manage conservation and restoration of westslope cutthroat trout, which is ultimately an expense born by the public. For the most part, FWP is self-funded through license fees and other hunting and fishing related fees.

2.2.6 Aesthetics and Recreation

11. Aesthetics and Recreation	Impact				Can Impact be Mitigated?	Comment Index
Would the proposed action result in:	Unknown	None	Minor	Potentially Significant		
a. Alteration of any scenic vista or creation of an aesthetically offensive site or effect that is open to public view?		X				
b. Alteration of the aesthetic character of a community or neighborhood?		X				
c. Alteration of the quality or quantity of recreational/tourism opportunities and settings? (Attach Tourism Report)			X		Yes	11c
d. Will any designated or proposed wild or scenic rivers, trails or wilderness areas be impacted? (Also see 11a, 11c)		X				

Comment 11c: Alteration of the Quality or Quantity of Recreational/Tourism Opportunities and Settings.

This project would result in temporary loss of angling opportunity in upper South Fork Sixteenmile Creek from the time of fish removal and for several years after fish stocking. South Fork Sixteenmile Creek would likely support a healthy population of westslope cutthroat trout within 5 years of project implementation. In most cases, cutthroat trout fisheries in streams are catch and release. After colonization of South Fork Sixteenmile Creek, FWP would evaluate the population to determine if it can support some harvest of westslope cutthroat trout. Nonetheless, this project would provide anglers a rare opportunity to fish for nonhybridized westslope cutthroat trout on the east side of the Continental Divide.

Angling pressure data for South Fork Sixteenmile Creek are sparse; however, data from 2009 indicated the stream ranked 1,244 in the state and 302 in the region (MFISH database), which indicates relatively low fishing pressure. All fishing pressure was from in-state anglers. Based on public use patterns of other westslope cutthroat trout restoration projects, it is unlikely that restoration of nonhybridized westslope cutthroat trout will increase public use or presence.

Cumulative Effects

The cumulative effects of the piscicide component of this project would be a 4-year span of no to marginal fishing as the westslope cutthroat trout reestablish. Stocking adults and juveniles would expedite reestablishment and result in immediate fishing opportunities. Imprinting fry using incubators or eggs boxes would provide an additional means of augmenting the populations. Despite the delay in reestablishing population size, growth of the new westslope cutthroat trout would be substantial, as competition for forage would be reduced. As a result, anglers would have the opportunity to catch relatively large westslope cutthroat trout for a small stream within a few years.

2.2.7 Cultural/Historical Resources

12. Cultural and Historical Resources	Impact				Can Impact be Mitigated?	Comment Index
Would the proposed action result in:	Unknown	None	Minor	Potentially Significant		
a. Destruction or alteration of any site, structure or object of prehistoric historic, or paleontological importance?		X				12a
b. Physical change that would affect unique cultural values?		X				
c. Effects on existing religious or sacred uses of a site or area?		X				12c
d. Will the project affect historic or cultural resources?		X				12a

Comment 12a: Effects on Features with Prehistoric, Historic, or Paleontological Importance.
Through its NEPA process, the GNF will complete a cultural resource survey at the barrier site. The proposed piscicide treatment would not affect any cultural sites in the project area.

Comment 12c: Effects on Existing Religious or Sacred Uses of a Site or Area.
The project site is located in the aboriginal range of several tribes. FWP sent a letter of consultation to their cultural officer on March 27, 2013. We will include any tribal concerns in the record of decision for this EA.

2.2.8 Summary Evaluation of Significance

13. Summary Evaluation of Significance	Impact				Can Impact be Mitigated?	Comment Index
Will the proposed action, considered as a whole:	Unknown	None	Minor	Potentially Significant		
a. Have impacts that are individually limited, but cumulatively considerable? (A project or program may result in impacts on two or more separate resources which create a significant effect when considered together or in total.)		X				
b. Involve potential risks or adverse effects which are uncertain but extremely hazardous if they were to occur?		X				
c. Potentially conflict with the substantive requirements of any local, state, or federal law, regulation, standard or formal plan?		X				
d. Establish a precedent or likelihood that future actions with significant environmental impacts will be proposed?		X				13d
e. Generate substantial debate or controversy about the nature of the impacts that would be created?	X	X			Yes	13e
f. Is the project expected to have organized opposition or generate substantial public controversy? (Also see 13e)	X	X				13f
g. List any federal or state permits required.						13g

Comment 13d: Establish a Precedent or Likelihood of Future Actions

This project does not establish a precedent or likelihood that additional projects with significant environmental projects would be proposed. The recent *Statewide Fisheries Management Plan* (FWP 2013) specifies a goal of restoring westslope cutthroat trout to 20% of historically occupied habitat. The proposed approach is to spread out populations geographically within the upper Missouri River basin. By not clumping populations, a catastrophic event in one area, such as wildfire, disease, flooding, or drought, would not have adverse effects on a large proportion of the populations of reestablished westslope cutthroat trout. Geographically separated populations may be spared the disturbance and provide a donor source to repopulate a damaged stream.

Another issue relating to future actions relates to opportunity to expand the project within the area. Reestablishing a population requires a sufficient amount of habitat to protect, at least 5 miles of stream (Hilderbrand and Kershner 2000). Another need is an appropriate site to

construct a barrier, which requires the lateral constraint of bedrock walls or a deeply incised channel. No other opportunities are available for the South Fork Sixteenmile Creek downstream of this project.

Comments 13e and F: Generate Debate, Controversy, or Organized Opposition

FWP and its conservation partners execute several piscicide projects every year and the public response is variable. Often projects receive little response. In other cases, native trout supporters provide enthusiastic support. Several high profile projects were the subject of substantial opposition. The level of support, controversy, or debate that this project would inspire is unknown. Educating the public on the value of native fish and the need for piscicides as a tool to meet conservation goals in an affordable and timely manner would be a component of limiting opposition and debate. In addition, dispelling misconceptions on toxicity to nontarget organisms, the response of aquatic invertebrate populations to piscicide, and its fate and transport is a means to mitigate the potential for opposition.

Comment 13g: Necessary Federal or State Permits

The barrier component of this project would require several permits, which will be described through the GNF's NEPA process. The piscicide phase requires a general permit for pesticide application (#MTG87000). FWP submitted a notice of intent to DEQ and received a letter of consent for piscicide application.

3.0 ALTERNATIVES

Three alternatives received consideration during preparation of the environmental assessment. The proposed alternative (alternative 2) was evaluated in detail. The others received less consideration as they would not meet the fisheries conservation goals.

3.1 Alternative 1: No Action

The no action alternative would result in continuation of the status quo with no barrier or fish removal and maintain the present angling quality and species diversity in South Fork Sixteenmile Creek. The project area would continue to support a hybridized trout population. Reestablishment of a nonhybridized population would not happen and the risk of extirpation of westslope cutthroat trout would continue.

3.2 Alternative 2: Proposed Action

The proposed action entails removing existing nonnative fish in upper South Fork Sixteenmile Creek above a concrete barrier and restocking the area with the nearest neighbor, nonhybridized westslope cutthroat trout. Other native species would be reintroduced if they are present before treatment, such as sculpin or longnose dace.

The predicted benefits of alternative 2 are:

- Reestablishment of a population of nonhybridized westslope cutthroat trout in 6 miles of the Sixteenmile Creek watershed;

- Replication of an existing population of nonhybridized westslope cutthroat trout in the Missouri River drainage;

- Potential reduction of justification for the inclusion of westslope cutthroat trout for protection under the Endangered Species Act;

- Provide a rare opportunity for anglers to fish for Montana's native trout in an accessible area of the GNF;

- Contribute towards meeting the objectives of the *Statewide Fisheries Management Plan* (FWP 2013) by securing a nonhybridized westslope cutthroat trout in a historically occupied portion of South Fork Sixteenmile Creek;

- Contribute towards meeting an objective of the cutthroat trout MOU, which calls for reestablishment of populations of westslope cutthroat trout within its historic range.

3.3 Alternative 3: Mechanical Removal

Under this alternative, field crews would use electrofishing or other physical means to target nonnative fishes. The difficulty in achieving 100% removal is a primary deficiency in using mechanical removal as an option. The level of effort associated with even incomplete removal can be substantial. For example, FWP mechanically removed brook trout from four miles of Muskrat Creek (Shepard et al. 2001). During the four-year effort, fieldworkers captured nearly 5,400 brook trout and moved them downstream from a constructed barrier. By the end of the project, brook trout were still present upstream of the barrier, and treatment with piscicide became the recommended alternative. Other researchers found five removals were required for successful elimination of rainbow trout from a stream in Tennessee (Kulp and Moore 2000); however, the stream length in this study was about 0.5 miles. In comparison, the South Fork Sixteenmile Creek area is over 6 miles, including several tributaries in steep, mountainous terrain.

In some cases, mechanical removal did not remove all nonnative fish; however, the native species benefited from reduced competition associated with this suppression. In a stream in Tennessee, electrofishing did not eliminate rainbow trout, although reduced numbers allowed brook trout to reestablish (Moore et al. 1983). Native cutthroat trout in a Wyoming stream displayed a similar response to mechanical removal of brook trout (Thompson and Rahel 1996).

The positive response of native trout is likely temporary, as remaining nonnatives will eventually rebound and exert the same competitive pressures on native species.

In the case of South Fork Sixteenmile Creek, incomplete removal of nonnatives would not meet project objectives. Notably, any remaining hybrids would spawn with westslope cutthroat trout, which would mean the loss of the genetically pure population and creation of a hybrid swarm. Considering the expense of the construction of a concrete barrier and the labor involved in the piscicide portion, not meeting the project objectives would produce an expensive failure.

In summary, mechanical removal of nonnatives would not result in attainment of project objective, and would entail considerable expense. The likelihood of removing 100% of nonnatives along more than 6 miles of stream in this rugged country is exceedingly low. Furthermore, mechanical removal would require the commitment of considerable time, labor, and resources to the project, and would extend the duration of the removal portion to a minimum of 4 to 5 years. Likewise, the remaining hybrids would continue to breed with the pure westslope cutthroat trout and brook trout would continue to exert competitive pressure on westslope cutthroat trout.

4.0 ENVIRONMENTAL ASSESSMENT CONCLUSION SECTION

4.1 Evaluation of Significance Criteria and Identification of the Need for an EIS

Evaluation of the potential effects on the physical and human environment in 2.0 ENVIRONMENTAL REVIEW provides the basis for determining the need for an environmental impact statement (EIS), which is a more rigorous evaluation of the potential impacts to human health and the environment from the proposed action. If evaluation of these significance criteria suggests the proposed action would result in significant impacts, an EIS would be required.

This environmental review demonstrates the impacts of the proposed project are not significant. All are short-term, minor, and can be mitigated. The proposed actions would benefit native westslope cutthroat trout and are consistent with the statewide fisheries plan (FWP 2013) and MOU (MCTSC 2007).

4.2 Level of Public Involvement

Several factors influence the appropriate level of public involvement for a given proposed action. Risks to human health, the environment, local economics, as well as the seriousness of the environmental issues are key considerations. This project will include a 30-day public comment period. The public will be informed of the potential project through press releases in local newspapers and through a notice on FWP's website (http://fwp.mt.gov/news/default.aspx). FWP and GNF will hold public meetings on February 18, 2014 (Bozeman Regional Headquarters) and

February 20, 2014 (the Old Sedan Schoolhouse) at 7 pm. to receive public input on the proposed project.

4.3 Public Comments

The public comment period will extend from February 7, 2014 to March 7, 2014.

Send comments to:

Montana Fish, Wildlife & Parks
c/o South Fork Sixteenmile Creek EA Comments
Ron Spoon
1400 So. 19th
Bozeman, MT 59715

4.4 Public Scoping Process During Draft EA Preparation

Public involvement during EA preparation was expanded during 2013 because WCT restoration was a relatively new concept for residents in the Sixteenmile Creek watershed. Comments received during the scoping process were important for preparing the alternatives presented in this EA.

Scoping letters were sent to 59 individuals, groups and agencies on 11 January 2013. Although only one written response to the scoping letter was received, several phone contacts indicated that there was significant landowner concern about the proposed project. In response to this concern, a public meeting was held on 20 February 2013 to present project objectives and receive feedback on project design and feasibility. Sixteen landowners, one grazing permittee, and one county commissioner attended the meeting or participated by conference call. Although the public was welcome to attend the meeting, the primary purpose of the meeting was to address landowner concerns and neighboring landowners were the only attendees.

Landowners listed several major issues during the public meeting in February 2013. These included concerns relating to the potential for alterations of the pristine nature of the area. Other issues related to effects on neighboring landowners. Specifically, they wanted to know the consequences of having a species with the possibility for ESA listing near their property, the likelihood of associated restrictions on land use, and the probability for future, downstream expansion onto private lands. Landowners also questioned the potential for long-term persistence of an isolated population in small headwater streams. Accounts from landowners observing fish movement downstream of the GNF boundary during low, summer flow raised a specific concern about the viability of the headwaters fishery.

In response to questions raised during the landowner scoping meeting, FWP added three steps to the EA preparation process. FWP biologists met with individual landowners to explain the Candidate Conservation Agreement with Assurances (CCAA) tool to protect landowners from restrictions on land use in the future. They also provided names and phone numbers of landowners who had direct experience with WCT restoration projects. To address the concern about the viability of a headwater population during the summer months, FWP collected monthly (June through September) fish population data during the summer of 2013. Finally, FWP delayed the release of the draft EA for several months to make the individual contacts and evaluate if fish were capable of persisting in these small, headwaters streams.

The following information is a summary of concerns **(bold print)**, and agency response to concerns expressed during the scoping process:

1) **You will upset the balance of the system and threaten a good fishery downstream.**

   Achieving a balance between maintaining sport fishing in the Sixteenmile drainage and restoring a reasonable genetic reserve of native cutthroat is one of FWPs primary goals for cutthroat trout conservation. Sixteenmile Creek is the only stream in the basin known to have maintained some nearly pure WCT. FWP has restricted the potential project area to this location in an attempt to avoid upsetting the balance of the big picture. FWP considered extending the project downstream, perhaps to below Troy Creek, as the additional habitat would support a larger genetic reserve on nonhybridized fish. However, FWP and partners decided to restrict the area to the smallest area that could be viable over the long term and not expand into private lands.

2) **There is no way to ensure that the introduction of cutthroat will take.**

   The presence of nearly pure WCT in the headwaters is the best indication that life history strategies of WCT are compatible with this system. If FWP proposed working on a stream that never had WCT, the suitability of the habitat would be questionable. As a result, FWP would be less confident in making the investment to reestablish natives. The presence of 4 major tributaries of the upper basin provides a variety of connected streams that provides additional security for long-term survival in case of a catastrophic event in the watershed. Existing habitat supports a hybridized WCT population year-round, and there is no reason a genetically pure WCT population would not persist under the current habitat and land management regime.

3) **The project displaces the current fishing opportunities.**

   Anglers occasionally fish upstream of the proposed barrier location, but most of the reintroduction area is too small for fishing. Most anglers would prefer to fish downstream of

the project area where the stream is larger, which is another reason FWP did not select a barrier site downstream.

4) **The fish in these waters survive some incredibly harsh winters**.

Native cutthroat trout have life history strategies that promote survival through winter in small streams. This is likely one of the strengths of WCT compared to nonnative trout. Montana's state fish has a reputation for being too fragile, as they do not persist in the presence of nonnative species. The remaining WCT populations in the Missouri River basin occupy similar small, headwater streams that face harsh winters. The ability of moderately hybridized WCT to remain in the uppermost reaches of South Fork Sixteenmile Creek compared to lower reaches, where rainbow trout are more abundant, suggests these hybridized fish retain the genetic traits to overwinter in small headwater streams.

5) Can introduced fish handle the stress of drought and low water?

At least two landowners made this point and FWP lacked data to address this concern in 2013. Subsequently, FWP sampled the proposed project area each month during the summer of 2013 to evaluate the ability of existing fishery to survive low summer flows. Crews marked 583 fish above the proposed barrier location during early summer. They returned to the stream during late summer to evaluate if fish had moved downstream during the relatively hot, dry summer of 2013.

Downstream of the proposed barrier, FWP sampled 254 fish in late summer (September 10th), and found no marked fish from upstream reaches. FWP also sampled upstream from the proposed barrier in late summer, and found a healthy population of fish in the proposed project area. Consistent with landowner observations, the density of rainbow trout and hybridized WCT was very high (80 to 100 fish per 100 meter section) downstream of the proposed barrier. FWP agrees that large numbers of fish reside in downstream reaches during periods of low summer flow. However, adequate habitat and significant numbers of fish remain in the upper reaches of the stream (40 to 50 fish per 100 meter section) and FWP found no evidence of fish out-migrating for thermal or flow refuge.

6) Concern that we might want to move downstream to expand the project in the future.

Design and construction of the fish passage barrier is expensive and tailored to a specific location on the stream. If this investment is made to install a barrier about 2 miles upstream of private property it would be nearly impossible to justify the expense of a new structure at a downstream location. FWP has worked on two projects (Whites Creek and Muskrat Creek) where WCT populations increased substantially, which caused FWP to install better fish barriers. In both situations, the new barriers were placed near the original project boundary without expanding the projects downstream.

In addition, landowners were concerned that WCT migrating downstream of the project area to private lands could result in land use restrictions if the fish becomes federally listed. As the primary conservation threat to WCT is hybridization with nonnative trout, any WCT migrating downstream from the project area would lose their conservation value. The USFWS considers WCT populations to be of conservation value only when 80% of the genes represented in the hybrid swarm are from WCT. Therefore, a few WCT among mostly rainbow trout would not qualify for protection.

7) Concern regarding disturbance of the "pristine" nature of area.

The primary disturbance related to the proposed project would occur during construction of the fish passage barrier. Construction equipment and concrete trucks may cause short-term disturbance of existing forest roads, which can be mitigated by seasonal timing and road maintenance. Temporary access using an existing closed road surface for approximately ¼ mile will require road reclamation, seeding, and weed control. The permanent concrete barrier will not be visible from existing roads.

8) Concern that the barrier will not function during spring run-off.

Although it is true extreme flow events pose risks to fish barriers, the structure is designed to function during 100-year flood events. This design results in relatively high costs for a structure on a relatively small stream, but the high cost is largely related to the ability to withstand significant spring flooding. The barrier location in a confined stream reach adjacent to a bedrock outcrop was selected specifically for its suitability to pass flood events with low risk of lateral stream migration.

9) "This beautiful species is not good at adapting to strong competition from rainbow and brown trout……I believe the ecosystem is fine the way it is."

The quote reflects the appreciation that landowners have for the existing fishery and it is a common sentiment when WCT projects are proposed. Several individuals resist the idea of removing perfectly good fish from a nice stream. If there were a way to establish a few secure genetic reserve areas for westslope cutthroat trout without removing nonnative fish, FWP would pursue that alternative. However, the barrier installation combined with removal of nonnative trout has proven to be an effective tool for balanced restoration.

In southwest Montana, 21 projects similar to the Sixteenmile Creek proposal have been completed in the past 10 years. Prior to this work, WCT only occupied 4.2% of the 11,000 miles of stream historically occupied by Montana's State fish, and this distribution was in decline. The 21 WCT recovery projects have added 167 miles of stream where isolated, genetically pure WCT populations are secure upstream of natural or human-made barriers. These projects increased the mileage of occupied stream from 4.2% to 5.7% of the historic

range. If the proposed project at Sixteenmile Creek is completed, the additional 6 miles of WCT habitat will increase the distribution by 0.1%. These small increments in occupied habitat accumulate and decrease justification for listing WCT.

Following this project, nonnative fish would continue to occupy 94.2% of the historic range of WCT. This percentage strongly favors nonnative trout and it leaves open the potential for federal listing of the species. Most importantly, future generations may not get the opportunity to see this native fish in its native habitat if FWP and partners cease WCT recovery projects.

4.5 Parties Responsible for Preparation of the EA

Dave Moser
Montana Fish, Wildlife & Parks
South Fork Sixteenmile Creek EA Comments
4600 Giant Springs Road
Great Falls, MT 59405

Carol Endicott
Montana Fish, Wildlife & Parks
Livingston Fisheries Office
1354 Highway 10 West
Livingston, MT 59047

5.0 LITERATURE CITED

AFS (American Fisheries Society). 2002. Rotenone stewardship program, fish management chemicals subcommittee. www.fisheries.org/rotenone/.

Allendorf, F.W., and R.F. Leary. 1988. Conservation and distribution of genetic variation in a polytypic species, the cutthroat trout. Conservation Biology 2:170-184.

Anderson, N.H. and J.B. Wallace. 1984. Habitat, life history, and behavioral adaptations of aquatic insects. Pages 38-58 in R.W. Merritt and K.W. Cummins (eds.), An introduction to the aquatic insects of North America. 2nd ed. Kendall/Hunt Publishing, Dubuque, Iowa.

Behnke, R. J. 1992. Native trout of western North America. American Fisheries Society Monograph 6, Bethesda, Maryland.

Betarbet, R., T.B. Sherer, G. MacKenzie, M. Garcia-Osuna, A.V. Panov, and T. Greenamyre. 2000. Chronic systemic pesticide exposure reproduces features of Parkinson's disease. Nature Neuroscience. 3 (12): 1301-1306.

Billman, H.G., C.G. Kruse, S. St-Hilaire, T.M. Koel, J.L. Arnold, and C.R. Peterson. 2012. Effects of rotenone on Columbia spotted frogs Rana luteiventris during field applications in lentic habitats in southwestern Montana. North American Journal of Fisheries Management. 32:781-789.

Boulton, A.J., C.G Peterson, N.B. Grimm, and S.G. Fisher. 1992. Stability of an aquatic macroinvertebrate community in a multiyear hydrologic disturbance regime. Ecology. 73 (6):2192-2207.

Bradbury, A. 1986. Rotenone and trout stocking: a literature review with special reference to Washington Department of Game's lake rehabilitation program. Fisheries management report 86-2. Washington Department of Game.

BRL (Biotech Research Laboratories). 1982. Analytical studies for detection of chromosomal aberrations in fruit flies, rats, mice, and horse bean. Report to U.S. Fish and Wildlife Service (USFWS Study 14-16-0009-80-54). National fishery research Laboratory, La Crosse, Wisconsin.

CDFG (California Department of Fish and Game), 1994. Rotenone use for fisheries management, July 1994, final programmatic environmental impact report. State of California Department of Fish and Game.

Chandler, J.H. and L.L. Marking. 1982. Toxicity of rotenone to selected aquatic invertebrates and frog larvae. The Progressive Fish Culturist. 44(2):78-80.

Cook, S.F. and R.L. Moore. 1969. The effects of a rotenone treatment on the insect fauna of a California stream. Transactions of the American Fisheries Society 83 (3):539-544.

Cutkomp, L.K. 1943. Toxicity of rotenone to animals: a review and comparison of responses shown by various species of insects, fishes, birds, mammals, etc. Soap and Sanitary Chemicals. 19(10):107-123.

Dawson, V.K., W.H. Gingerich, R.A. Davis, and P.A. Gilderhus. 1991. Rotenone persistence in freshwater ponds: effects of temperature and sediment adsorption. North American Journal of Fisheries Management. 11:226-231.

Dunham, J.B., S.B. Adams, R.E. Schroeter, and D.C. Novinger. 2002. Alien invasions in aquatic ecosystems: toward an understanding of brook trout invasions and potential impacts on

inland cutthroat trout in western North America. Reviews in Fish Biology and Fisheries. 12:373-391.

Engel LS, Seixas NS, Keifer MC, Longstreth WTJ & Checkoway H. 2001. Validity study of self-reported pesticide exposure among orchardists. J Expo Anal Environ Epidemiol, 11, 359–368

Engstrom-Heg, R, R.T. Colesante, and E. Silco.1978. Rotenone tolerances of stream-bottom insects. New York Fish and Game Journal. 25 (1):31-41.

Engstrom-Heg, R. 1971. Direct measure of potassium permanganate demand and residual potassium permanganate. New York Fish and Game Journal. 18(2):117-122.

Engstrom-Heg, R. 1972. Kinetics of rotenone-potassium permanganate reactions as applied to the protection of trout streams. New York Fish & Game Journal 19(1):47–58.

EPA, 2007. United States Environmental Protection Agency, prevention, pesticides and toxic substances (7508P). EPA 738-R-07-005. Reregistration Eligibility Decision for Rotenone, List A Case No. 0255.

Finlayson, B.J., R.A. Schnick, R.L. Cailteux, L. DeMong, W.D. Horton, W. McClay, C.W. Thompson, and G.J. Tichacek. 2000. Rotenone use in fisheries management: administrative and technical guidelines manual. American Fisheries Society, Bethesda, Maryland.

Firestone, J.A., J.I. Lundin, K.M. Powers, T. Smith-Weller, G.M. Franklin, P.D. Swanson, W.T.Longstreth Jr., and H. Checkoway. 2010. Occupational factors and risk of Parkinson’sdisease: a population-based case-control study. American Journal of Industrial Medicine 53:217-223.

Fisher, J.P. 2007. Screening level risk analysis of previously unidentified rotenone formulation constituents associated with the treatment of Lake Davis. for California Department of Fish and Game. Environ International Corporation, Seattle, Washington.

FWP. 2012. Wild fish transfer policy (revised). Montana Fish, Wildlife & Parks, Fisheries Bureau. Helena, Montana 59620

FWP. 2013. Statewide Fisheries Management Plan – 2013 to 2018. Helena, Montana

Gilderhus, P.A., J.L. Allen, and V.K. Dawson. 1986. Persistence of rotenone in ponds at different temperatures. North American Journal of Fisheries Management. 6: 129-130.

Gilderhus, P.A., V.K. Dawson, and J.L. Allen. 1988. Deposition and persistence of rotenone in shallow ponds during cold and warm seasons. US Fish and Wildlife Service Investigations in Fish Control, No.5

Gingerich, W. and J. Rach. 1985. Uptake, accumulation and depuration of 14C-rotenone in blue gills (Lepomis macrochirus). Aquatic Toxicology 6:170-196.

Glacier National Park. 2011. Resource hot topics: saving Glacier's native fish. Crown of the Continent Research Learning Center, National Park Service, U.S. Department of the Interior.

Gleason, M., R. Gosselin, H. Hodge, and P. Smith 1969. Clinical toxicology of commercial products. The William and Wilkins Company, Baltimore, Maryland.

Grisak, G.G., D. R. Skaar, G. L. Michael, M.E. Schnee and B.L. Marotz. 2007. Toxicity of Fintrol (antimycin) and Prenfish (rotenone) to three amphibian species. Intermountain Journal of Sciences. 13(1):1-8.

Groves, C.L., W.B. Ballard and R.H. Jessup. 1988. Long distance movements by an adult wolverine. Journal of Mammology 67:181-185.

Guenther, H., M. Schaefer and 19 others. 2011. Rotenone Review Advisory Committee Final Report and Recommendations to the Arizona Game and Fish Department. http://www.azgfd.gov/h_f/documents/Rotenone_Review_Advisory_Committee_Final_Report_12_31_2011.pdf.

Hertzman C, Wiens M, Snow B, Kelly S & Calne D. 1994. A case–control study of Parkinson's disease in a horticultural region of British Columbia. Mov Disord, 90: 69–75

Hilderbrand, R.H. and J.L. Kershner. 2000. Conserving inland cutthroat trout in small streams: How much stream is enough? North American Journal of Fisheries Management 20:513-520.

Hisata, J.S. 2002. Lake and stream rehabilitation: rotenone use and health risks. Final supplemental environmental impact statement. Washington Department of Fish and Wildlife, Olympia. Washington.

Hitt, N.P., C.A. Frissell, C.C. Muhlfeld, and F.W. Allendorf. 2003. Spread of hybridization between native westslope cutthroat trout, *Oncorhynchus clarkii lewisi*, and nonnative rainbow trout, *Oncorhynchus mykiss*. Canadian Journal of Fisheries and Aquatic Sciences. 60:1440-1451.

Houf, L.J. and R.S. Campbell. 1977. Effects of antimycin a and rotenone on macrobenthos in ponds. Investigations in fish control number 80. U.S. Fish and Wildlife Service. Fish Control Laboratory, LaCrosse, Wisconsin.

HRI (Hazelton Raltech Laboratories). 1982. Teratology studies with rotenone in rats. Report to U.S. Geological Survey. Upper Midwest Environmental Sciences Center (USFWS Study 81-178). La Crosse, Wisconsin.

Hubble JP, Cao T, Hassanein RES, Neuberger JS & Koller WC. 1993 Risk factors for Parkinson's disease. Neurology, 43:1693-1697.

Jelks. E. Williams and 15 other authors. 2008. Conservation status of imperiled North American freshwater and diadromous fishes. Fisheries. 33:372-407.

Jiménez-Jiménez FJ, Mateo D & Giménez-Roldán S. 1992. Exposure to well water and pesticides in Parkinson's disease: Acase–control study in the Madrid area. Mov Disord, 7, 149–152

Kulp, M.A. and S. E. Moore. 2000. Multiple electrofishing removals fore eliminating rainbow trout in a small southern Appalachian stream. North American Journal of Fisheries Management 20:259–266.

Lai, BCL, Marion SA, Teschke K & Tsui JKC. 2002. Occupational and environmental risk factors for Parkinson's disease. Parkinsonism Rel Disord, 8:297–309

Ling, N. 2002: Rotenone, a review of its toxicity and use for fisheries management. New Zealand Department of Conservation. Science for Conservation. 211:40 p.

Loeb, H.A. and R. Engstrom-Heg. 1970. Time-dependant changes in toxicity of rotenone dispersions to trout. Toxicology and Applied Pharmacology. 17:605-614.

Marking, L.L. 1988. Oral toxicity of rotenone to mammals. Investigations in fish control, technical report 94. U.S, Fish and Wildlife Service, National Fisheries Research Center, La Crosse, Wisconsin.

Matthaei, C.D., Uehlinger, U., Meyer, E.I., Frutiger, A. 1996. Recolonization by benthic invertebrates after experimental disturbance in a Swiss prealpine river. Freshwater Biology. 35(2):233-248.

Maxell, B. A., and D. G. Hokit. 1999. Amphibians and Reptiles. Pages 2.1-2.29 in G. Joslin and H. Youmans, coordinators. Effects of recreation on Rocky Mountain wildlife: A Review for Montana. Committee on Effects of Recreation on Wildlife, Montana Chapter of The Wildlife Society. 307pp.

Mihuc, T.B. and G. W. Minshall. 1995.Trophic generalists vs. trophic specialists: implications for food web dynamics in post-fire streams. Ecology 76(8):2361-2372

Minshall, G.W. 2003. Responses of stream benthic invertebrates to fire. Forest Ecology and Management. 178:155-161.

Montana Cutthroat Trout Steering Committee (MCTSC). 2007. Memorandum of understanding and conservation agreement for westslope cutthroat trout and Westslope cutthroat trout in Montana.

Montana Natural Heritage Program and Montana Fish Wildlife & Parks. 2012. Montana Animal Species of Concern. Gallatin, Montana: Montana Natural Heritage Program and Montana Department of Fish, Wildlife & Parks.

Moore, S. E., B. L. Ridley, and G. L. Larson. 1983. Standing crops of brook trout concurrent with removal of rainbow trout from selected streams in Great Smoky Mountains National Park. North American Journal of Fisheries Management 3:72–80.

National Academy of Sciences NAS. 1983. Drinking water and health, volume 5. Safe Drinking Water Committee Board of Toxicology and Environmental Health Hazards, Commission on Life Sciences, National Research Council, National Academy Press, Washington DC.

ODFW, 2002. Questions and answers about rotenone from Oregon Department of Fish and Wildlife web page, Diamond Lake rotenone treatment, www.dfw.state.or/ODFWhtml/InfoCntrFish/DiamondLake.Rotenone.html.

Pennack, 1989. Freshwater Invertebrates of the United States, John Wouldey & Sons and Company, New York, New York.

Peterson, D.P., K.D. Fausch and G.C. White. 2004. Population ecology of an invasion: effects of brook trout on native cutthroat trout. Ecological Applications. 14(3):754-772.

Prentiss Incorporated. 2007a. Product label for CFT Legumine fish toxicant, 5% liquid formulation of rotenone. Sandersville, Georgia

Prentiss Incorporated. 2007b. Product label for Prentos fish toxicant, 7.4 % powder formulation of rotenone. Sandersville, Georgia.

Raffaele, K.C., S.V. Vulimiri, and T.F.Bateson. 2011. Benefits and barriers to using epidemiology data in environmental risk assessment. The Open Epidemiology Journal 4:99-105.

Schnick, R. A. 1974. A review of the literature on the use of rotenone in fisheries. USDI Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife, LaCrosse, Wisconsin.

Shepard, B.B., R. Spoon and L. Nelson. 2001. Westslope cutthroat trout restoration in Muskrat Creek, Boulder River drainage, Montana. Progress report for period 1993 to 2000. Montana Fish, Wildlife & Parks, Townsend

Shepard, B.B., B.E. May, and W. Urie. 2005. Status and conservation of westslope cutthroat trout within the western United States. North American Journal of Fisheries Management. 25:1426-1440.

Skaar, D. 2001. A brief summary of the persistence and toxic effects of rotenone. Montana Fish, Wildlife & Parks, Helena.

Spencer, F. and L.T. Sing. 1982. Reproductive responses to rotenone during decidualized pseudogestation and gestation in rats. Bulletin of Environmental Contamination and Toxicology. 228:360-368.

Tanner, C. M., Kamel, and 19 other authors. 2011. Rotenone, paraquat, and Parkinson's disease. Environmental Health Perspectives. 119:866-872

Teixeira, J.R.M., A.J. Lapa, C. Souccar, and J.R. Valle. 1984. Timbós: ichthyotoxic plants used by Brazilian Indians. Journal of Ethnopharmacology. 10:311-318

Thompson, P. D., and F. J. Rahel. 1996. Evaluation of depletion-removal electrofishing of brook trout in small Rocky Mountain streams. North American Journal of Fisheries Management 16:332–339

Van Goethem, D, B. Barnhart, and S. Fotopoulos. 1981. Mutagenicity studies on rotenone. Report to U.S. Geological Survey. Upper Midwest Environmental Sciences Center (USFWS Study 14-16-009-80-076), La Crosse, Wisconsin

Ware, G.W. 2002. An introduction to insecticides 3rd edition. University of Arizona, Department of Entomology, Tuscon. on EXTOXNET. Extension Toxicology Network. Oregon State University web page.

Wohl, N.E. and R. F. Carline. 1996. Relations among riparian grazing, sediment loads, macroinvertebrates, and fishes in three Pennsylvania streams. Canadian Journal of Fisheries and Aquatic Sciences. 53:260-266.

Yellowstone National Park. 2010. Native fish conservation plan: environmental assessment. National Park Service, U.S. Department of the Interior.